DOCUMENT RESUME

ED 301 716	CE 051 493
TITLE	Fundamentals of Construction. Introduction to Construction Series. Instructor Edition.
INSTITUTION	Associated General Contractors of America, Washington, D.C.; Oklahoma State Dept. of Vocational and Technical Education, Stillwater. Curriculum and Instructional Materials Center.
PUB DATE	88
NOTE	792p.; For related documents, see CE 051 494-499. Document contains colored paper.
AVAILABLE FROM	Associated General Contractors of America, Manpower and Training Services, 1957 E Street, NW, Washington, DC 20006 (Order No. 64--$30.00).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF05/PC32 Plus Postage.
DESCRIPTORS	Behavioral Objectives; *Building Trades; Competency Based Education; *Construction (Process); *Construction Industry; Curriculum Guides; Equipment; Learning Activities; Postsecondary Education; Secondary Education; Student Evaluation; Tests; *Trade and Industrial Education; Transparencies

ABSTRACT

This competency-based curriculum guide begins the Introduction to Construction series. The series is designed with the flexible training requirements of open shop contractors, preapprenticeship programs, multicraft high school programs, technology education programs, and cooperative education programs in mind. This guide contains 3 sections and 15 instructional units: industry orientation (free enterprise system, infrastructure of the United States, starting a business, industry orientation, becoming a good leader, job advancement), basic construction knowledge (orientation to safety and basic first aid, basic math, measuring, basic plan reading, builder's level and transit, site layout), and related equipment (tools and equipment related to all crafts, ladders and scaffolds, rigging and material handling). Eight basic components form a unit of instruction: performance objectives (unit and specific objectives), suggested activities for the teacher (an outline of unit contents and an instructor's guide), information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. (YLB)

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The Associated General Contractors of America

OKLAHOMA STATE BOARD OF VOCATIONAL AND TECHNICAL EDUCATION

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Fundamentals of Construction

CE051493

Introduction to Construction Series

instructor edition

88-005516

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Fundamentals of Construction

Developed as a Cooperative Project by
The Associated General Contractors of America
William K. Healy, Chairman, Manpower and Training Committee
and
Oklahoma State Board of Vocational and Technical Education
John Folks, Chairman
Roy Peters, Jr., Director

88-005516

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FUNDAMENTALS OF CONSTRUCTION
COMPETENCY PROFILE

Student ______________________________ Soc. Sec. No. ______ – ____ – ______
Last First MI

PROGRAM ______________________ Grade 9 10 11 12 Adult SCHOOL ______________________

INSTRUCTOR ______________________ SCHOOL ADDRESS ______________________ PHONE ______________

STUDENT'S HOME ADDRESS ______________________ DATE OF BIRTH ______________________ PHONE ______________

STUDENT'S EMPLOYER ______________________ ADDRESS ______________________ PHONE ______________

CONTACT IN CASE OF EMERGENCY ______________________ PHONE ______________

ADDRESS ______________________

OR ______________________

ADDRESS ______________________ PHONE ______________

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ON-JOB TRAINING/WORK EXPERIENCE

DURATION OF EMPLOYMENT	JOB TITLE	EMPLOYER	SUPERVISOR'S NAME	ADDRESS OF EMPLOYER	PHONE

This agency does not discriminate on the basis of race, creed, color, national origin, sex, age, veteran status, qualified handicap, or disability.

SPECIFIC JOB COMPETENCIES

Directions: Evaluate the trainee using the rating scale below and check the appropriate number to indicate the degree of competency achieved. The numerical ratings of 4, 3, 2, 1, and 0 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on level of student performance for each of the tasks listed below. The written test score line is provided for optional teacher use. It may not be applicable in all cases. "NA" is an appropriate entry in such instances.

Rating Scale:
4 — Skilled — can perform independently with no additional training
3 — Moderately Skilled — has performed independently during training program, limited additional training may be required
2 — Limited Practice — has practiced during training program, additional training is required to develop skill
1 — Exposure Only — general information provided with no practice time, close supervision needed and additional training required
0 — No Exposure — no information nor practice provided during training program, complete training required

4 3 2 1 0

Free-Enterprise System

☐☐☐☐☐ 1. Analyze supply and demand
☐☐☐☐☐ 2. ______________________

WRITTEN TEST SCORE ______________

4 3 2 1 0

America's Infrastructure

☐☐☐☐☐ 1. Discuss the present condition of the nation's infrastructure
☐☐☐☐☐ 2. ______________________

WRITTEN TEST SCORE ______________

4 3 2 1 0

Starting a Business

☐☐☐☐☐ 1. Write a plan for small business ownership
☐☐☐☐☐ 2. Prepare documentation required for a loan application
☐☐☐☐☐ 3. Evaluate own potential to start a business
☐☐☐☐☐ 4. ______________________

WRITTEN TEST SCORE ______________

4 3 2 1 0

Industry Orientation

☐☐☐☐☐ 1. Write a resume
☐☐☐☐☐ 2. Write a letter of application
☐☐☐☐☐ 3. Complete an employment application
☐☐☐☐☐ 4. Make an interview appointment by telephone for a construction job
☐☐☐☐☐ 5. Write a follow-up letter or make a follow-up telephone call after interviewing for a construction job
☐☐☐☐☐ 6. Complete an Employment Eligibility Verification (Form I-9)
☐☐☐☐☐ 7. ______________________

WRITTEN TEST SCORE ______________

4 3 2 1 0

Becoming a Good Leader

☐☐☐☐☐ 1. ______________________

WRITTEN TEST SCORE ______________

4 3 2 1 0

☐☐☐☐☐ *Job Advancement*

☐☐☐☐☐ 1. Develop a program for self-improvement

☐☐☐☐☐ 2. ______________________________

WRITTEN TEST SCORE ____________________

4 3 2 1 0

☐☐☐☐☐ *Orientation to Safety and Basic First Aid*

☐☐☐☐☐ 1. Lift a heavy object properly

☐☐☐☐☐ 2. ______________________________

WRITTEN TEST SCORE ____________________

4 3 2 1 0

☐☐☐☐☐ *Basic Math*

☐☐☐☐☐ 1. Add whole numbers

☐☐☐☐☐ 2. Subtract whole numbers

☐☐☐☐☐ 3. Multiply whole numbers

☐☐☐☐☐ 4. Divide whole numbers

☐☐☐☐☐ 5. Reduce fractions to lowest terms

☐☐☐☐☐ 6. Convert mixed numbers to improper fractions

☐☐☐☐☐ 7. Convert improper fractions to mixed numbers

☐☐☐☐☐ 8. Add fractions

☐☐☐☐☐ 9. Subtract fractions

☐☐☐☐☐ 10. Multiply fractions

☐☐☐☐☐ 11. Divide fractions

☐☐☐☐☐ 12. Add decimal numbers

☐☐☐☐☐ 13. Subtract decimal numbers

☐☐☐☐☐ 14. Multiply decimal numbers

☐☐☐☐☐ 15. Divide decimal numbers

☐☐☐☐☐ 16. Convert fractions to decimal numbers and percentages

☐☐☐☐☐ 17. Convert percentages to fractions and decimal numbers

☐☐☐☐☐ 18. Solve percentage problems

☐☐☐☐☐ 19. Calculate area of geometric figures

☐☐☐☐☐ 20. Calculate volume of solid figures

☐☐☐☐☐ 21. Solve basic ratio and proportion problems

☐☐☐☐☐ 22. ______________________________

WRITTEN TEST SCORE ____________________

4 3 2 1 0

☐☐☐☐☐ *Measuring*

☐☐☐☐☐ 1. Read a folding rule to the nearest fraction of an inch

☐☐☐☐☐ 2. Convert fractional inches to hundredths of a foot

☐☐☐☐☐ 3. Read an engineer's rule to the nearest hundredth of a foot

☐☐☐☐☐ 4. Read a tape to the nearest fraction of an inch

☐☐☐☐☐ 5. Measure objects

☐☐☐☐☐ 6. Use basic measuring tools and the 3-4-5 method to lay out the perimeter of a building on a concrete slab

☐☐☐☐☐ 7. ______________________________

WRITTEN TEST SCORE ____________________

4 3 2 1 0

☐☐☐☐☐ *Basic Plan Reading*

☐☐☐☐☐ 1. Read an architect's scale

☐☐☐☐☐ 2. Read plans

☐☐☐☐☐ 3. Read written specifications

☐☐☐☐☐ 4. ______________________________

WRITTEN TEST SCORE ____________________

4 3 2 1 0

☐☐☐☐☐ *Builder's Level and Transit*

☐☐☐☐☐ 1. Read a direct-reading rod

☐☐☐☐☐ 2. Identify hand signals used by the instrument person to guide the rod person

☐☐☐☐☐ 3. Set up and adjust a builder's level

☐☐☐☐☐ 4. Connect plumb bob to transit

☐☐☐☐☐ 5. Set up and adjust a combination level-transit

☐☐☐☐☐ 6. Use a combination level-transit to locate building-line points on batter boards

☐☐☐☐☐ 7. ______________________________

WRITTEN TEST SCORE ____________________

4 3 2 1 0

☐☐☐☐☐ *Site Layout*

☐☐☐☐☐ 1. Erect batter boards and locate building lines for a structure

☐☐☐☐☐ 2. Lay out footings for a structure

☐☐☐☐☐ 3. Set grade stakes for footings without forms

☐☐☐☐☐ 4. ______________________________

WRITTEN TEST SCORE ____________________

4 3 2 1 0

☐☐☐☐☐ *Tools and Equipment Related to All Crafts*

☐☐☐☐☐ 1. Identify hand tools and equipment used by all crafts

☐☐☐☐☐ 2. Identify power tools and equipment used by all crafts

☐☐☐☐☐ 3. Identify equipment used for specific construction jobs

☐☐☐☐☐ 4. Distinguish among hand signals used in maneuvering operations

☐☐☐☐☐ 5. Distinguish among hand signals used in forklift operations

☐☐☐☐☐ 6. ______________________________

WRITTEN TEST SCORE ____________________

4 3 2 1 0

☐☐☐☐☐ *Ladders and Scaffolds*

☐☐☐☐☐ 1. State safety precautions for ladders and scaffolds

☐☐☐☐☐ 2. Set up a section of scaffold

☐☐☐☐☐ 3. ______________________________

WRITTEN TEST SCORE ____________________

4 3 2 1 0

☐☐☐☐☐ *Rigging and Material Handling*

☐☐☐☐☐ 1. State safety tips related to rigging

☐☐☐☐☐ 2. State precautions to observe when caring for ropes

☐☐☐☐☐ 3. Distinguish among hand signals used in rigging operations

☐☐☐☐☐ 4. Tie knots

☐☐☐☐☐ 5. Install wire rope clips

☐☐☐☐☐ 6. Rig and handle different types of loads, using proper hand signals

☐☐☐☐☐ 7. ______________________________

WRITTEN TEST SCORE ____________________

Use of This Document

This document can be used to record information about the student and the skills mastered by the student. This information is useful in documenting student progress during the training program and to provide information about the student's qualifications to potential employers and for entry into advanced training programs. Instructors using AGC-CIMC instructional materials are authorized to reproduce this document as required for use in their training programs.

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FOREWORD

In 1985 The Associated General Contractors of America (AGC) met with representatives of the Oklahoma Curriculum and Instructional Materials Center (CIMC) to discuss the possibilities of developing, as a cooperative project, a course of instruction designed for training individuals who choose to seriously explore careers in construction.

This publication is the result of those original discussions and close coordination among general contractors and vocational educators. This series represents a conscious effort to coordinate the practical experience of personnel in the construction industry with the best instructional methods of those in the field of vocational education.

Although this series reflects a systematic approach to instructional materials development and the latest in educational technology innovations, the information in *Fundamentals of Construction* should be adapted and modified to coincide with local conditions.

Roy Peters, Jr., Director
Oklahoma State Department of
Vocational and Technical Education

William K. Healy, Chairman
Manpower and Training Committee
The Associated General Contractors
of America

PREFACE

For many years The Associated General Contractors of America (AGC) has recognized the need for providing quality competency-based instructional materials for the construction industry. AGC and the Oklahoma State Department of Vocational and Technical Education have met this challenge by providing nationally recognized curriculum and services since 1972. In 1986 AGC and Oklahoma's Curriculum and Instructional Materials Center (CIMC) determined a significant need for a series that would address training needs of open shop contractors, preapprenticeship programs, multi-craft high school programs, technology education programs, CVET, and cooperative education programs. The Introduction to Construction Series was designed with the flexible training requirements of these groups in mind.

The Introduction to Construction Series begins with *Fundamentals of Construction* and progresses to twelve spin-off specialty publications. *Fundamentals of Construction* covers basic knowledge necessary for all individuals in construction. Specialty areas are titled: *Introduction to Carpentry; Introduction to Bricklaying; Introduction to Concrete Masonry; Introduction to Ironwork; Introduction to Electricity; Introduction to Plumbing; Introduction to Heating, Ventilation, and Air Conditioning; Introduction to Sheet Metal; Introduction to Roofing; Introduction to Drywall; Introduction to Insulation; and Introduction to Welding.* Each specialty area covers basic skills necessary for entry-level employment. Both vocational education and the construction industry offer more advanced courses in each specialty area and should be considered by individuals wishing to establish careers in the industry. Competency profiles (provided in the teacher edition) for the Introduction to Construction Series articulate with several more advanced AGC publications as well as publications developed by the Mid-America Vocational Curriculum Consortium (MAVCC).

ACKNOWLEDGEMENTS

Appreciation is expressed to the many individuals who contributed their time, talents, and knowledge in the preparation of the revision of this manual.

Thank you to the following *ad hoc* committee members, staff representatives of The Associated General Contractors, and to the staff of the Oklahoma State Department of Vocational and Technical Education.

William K. Healy, Chairman
Manpower and Training Committee
The Associated General Contractors of America
John E. Healy and Sons, Inc.
New Castle, Delaware

Ed A. Proefke
F.O.C. Curriculum Ad Hoc Chairman
Proefke Enterprises
Dunedin, Florida

AGC Committee Members

William W. Brown
Ben Hur Construction Company
St. Louis, Missouri

John W. Friedemann
Training Program Coordinator
AGC/CIMC
Stillwater, Oklahoma

David F. Gray
Gray Construction Company, Inc.
Houston, Texas

John Hinkson, Administrator
St. Louis Carpenter Joint Apprenticeship Program
St. Louis, Missouri

Richard J. Hart
Blount Brothers Corporation
Montgomery, Alabama

John A. Heffner, Associate Director
Manpower and Training Services
The Associated General Contractors of America
Washington, D.C.

Lewis S. Kimball
Kimball Construction Company
Towson, Maryland

Special appreciation is extended to Don Boyles, State Department of Vocational and Technical Education; Bill Brown of Ben Hur Construction Company; John Hinkson, St. Louis Carpenter Joint Apprenticeship Program, St. Louis, Missouri; and John Friedemann, Training Program Coordinator, AGC/CIMC who gave much of their time, support, and expertise.

I would also like to thank the following people for their contributions to this publication: Al Maguire, Vice President, Concrete Systems, Nelson and Sloan Transit-Mixed Concrete, Chula Vista, California; Brett Barrowman, Advertising Department, Caterpillar Paving Products, Oklahoma City, Oklahoma; Jack Burnett, Glencoe Manufacturing Company, Glencoe, Oklahoma; David C. Gravhaling, Roofers Supply Inc., Oklahoma City, Oklahoma; Timothy C. Bradley, Plumbing Instructor, and Max W. Kinsch, Sheet Metal Instructor, Tulsa-Memorial Campus AVTS, Tulsa, Oklahoma; John D. Parnell, Bricklayer Instructor, Tri-County AVTS, Bartlesville, Oklahoma; William C. Potts, Bricklayer Instructor, Caddo Kiowa AVTS, Fort Cobb, Oklahoma; and Lloyd V. Kalka, Air Conditioning and Refrigeration Instructor, Gordon Cooper AVTS, Shawnee, Oklahoma.

Laborn J. (Bud) Hendrix
Curriculum Writer
The Associated General Contractors of America

USE OF THIS PUBLICATION

Instructional Units

Fundamentals of Construction contains three sections and fifteen instructional units. This format includes eight basic components that form a unit of instruction: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. Depending on the specific objectives, there may or may not be transparency masters, supplements, assignment sheets, or job sheets included in the unit of instruction.

All of the unit components "zero in" on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the teacher will help determine the following

- Amount of material that can be covered in each class period
- Skills that must be demonstrated
    Supplies and equipment needed
    Amount of practice needed
    Amount of class time needed for demonstrations
- Supplementary materials, such as pamphlets and filmstrips, that must be ordered
- Resource people to contact

Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the performance necessary to reach the unit objective. Since the objectives of the unit provide direction for the teaching/learning process, it is important that teachers and students have a common understanding of the intent of the objectives.

The objective sheet should be given to students and referred to throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught.

The objective sheet may also be used as a quick pretest to determine students' prior knowledge and to determine whether further study or activities are necessary. Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When changes in objectives are made, the teacher should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities (pink pages), instructor edition only

The suggested activities pages include an outline of the unit contents and an instructor's guide designed to assist teachers in planning their presentation of the unit. The instructor's guide provides suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audiovisual materials prepared, and outside resources contacted. Duties of the teacher will vary according to the particular unit.

The references that are listed in the suggested activities are ones used in the development of each unit. They may be used by the teacher to supplement her or his knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

All references in this publication were known to exist at the time of the writing of this publication. AGC/CIMC assumes no responsibility to provide these materials and cannot ensure the availability of these materials as individual vendors, manufacturers, and publishers may discontinue these products at any time.

The suggested activities section of the unit also includes supplements and transparency masters. Each of these components provides information in a special way. Supplements may consist of motivational materials, review or practice materials such as crossword puzzles and self-tests, or charts and reference materials. Supplements are designed to be copied and distributed to individual class members or to the class as a whole. Suggestions for their use are included in the instructor's guide. Transparencies direct the class' attention to the topic of discussion. Transparencies may present new information, or they may reinforce information presented in the information sheet. They are particularly effective when identification or analysis is necessary.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical-outline form and is keyed to the specific objectives.

Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, or provide motivation for each unit.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience. They assist students in the application of knowledges that are necessary prerequisites to skill development. Assignment sheets may be given to the student for completion in class or may be used for homework assignments. Answer sheets are provided when appropriate and can be used by the student and/or teacher for checking student progress. The scores of those assignment sheets listed in the specific objectives should be averaged with the unit test score, as the skills addressed in these assignment sheets are considered necessary in meeting the unit objective.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

The teacher should demonstrate to students the procedures outlined in each job sheet. Furthermore, the teacher needs to localize the job sheet according to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Job sheet performance should be evaluated by the instructor and averaged with the unit test score, as the skills addressed in the job sheets are considered necessary in meeting the unit objective.

Tests (white pages), instructor edition only

The test provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pencil and performance objectives must be evaluated.

It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test, 80 percent in most units, may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each question. The final unit grade should be obtained by using the paper/pencil score and evaluations of student demonstrations of the desired skills. Tests are printed on white paper and may be duplicated for classroom use.

Answers to Test and Assignment Sheets (pink pages)

Answers to test and assignment sheets are components designed to assist the teacher in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center (CIMC) is assigned a specific abbreviation. For example, *Fundamentals of Construction* has been abbreviated FOC. The units are then numbered consecutively within each section. An example of a page number is FOC-1-A. Since CIMC publications are loose leaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

Methods of Disseminating Material

For best results, provide student materials for each student. Student materials contain everything but the test, supplements, answers to assignment sheets and tests, and suggested activities.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

Competency Profiles

Competency profiles are used to document student performance. The profile contains a list of the specific job competencies that a student should achieve prior to leaving the training program. A competency profile master for the Introduction to Construction Series is provided in the instructor edition of each publication. Duplicate the profile and distribute to students as required.

Other AGC Publications: AGC updates curriculum products on a continuing basis. For a free catalog describing other AGC products, call the AGC National office at 1-202-393-2040.

CORRECTIONS AND SUGGESTIONS

The Curriculum and Instructional Materials Center (CIMC) wants to provide vocational instructors and students with materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications, or have suggestions for improving their usefulness in vocational programs, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and to indicate the correction on the copy. You can mail the information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, it is important that you notify the CIMC of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Coordinator for Curriculum Development
Curriculum and Instructional Materials Center
Oklahoma State Department of Vocational and
Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074

FREE-ENTERPRISE SYSTEM
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to explain how the free-enterprise system works. The student will show this ability by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with the free-enterprise system.
2. Match components of an economic system to their correct descriptions.
3. List the functions of an economic system.
4. Match types of economic systems to their correct descriptions.
5. Describe characteristics of a free-enterprise economy.
6. State facts about goods, services, and resources in a free-enterprise economy.
7. Select from a list facts about producers in a free-enterprise economy.
8. Select from a list facts about consumers in a free-enterprise economy.
9. List ways in which price is determined in a free-enterprise economy.
10. Select from a list ways in which price influences flow in a free-enterprise economy.
11. Discuss the role of government in a free-enterprise system.
12. Match to their correct descriptions economic goals in a free-enterprise system.
13. Analyze supply and demand.

FREE-ENTERPRISE SYSTEM
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplement #1 — Free-Enterprise System Crossword Puzzle

   D. Transparency master: TM #1 — Free-Enterprise Flow Chart

   E. Information sheet

   F. Assignment sheets

      1. Assignment Sheet #1 — Analyze Characteristics of a Free-Enterprise Economy

      2. Assignment Sheet #2 — Interpret a Free-Enterprise Flow Chart

      3. Assignment Sheet #3 — Interpret Price Influences in a Free-Enterprise Economy

      4. Assignment Sheet #4 — Collect Information on the Role of Government in a Free-Enterprise Economy

      5. Assignment Sheet #5 — Analyze Supply and Demand

   G. Answers to assignment sheets

   H. Test

   I. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials necessary to supplement unit.

      1. Competency profiles

         (NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006; phone (202-393-2040.)

SUGGESTED ACTIVITIES

2. Copies of Supplement #1

3. Films

   a. *American Enterprise Series: Land.* Color, 29 minutes, Modern Talking Picture Service, 1976.

   b. *American Enterprise Series: Government.* Color, 29 minutes, Modern Talking Picture Service, 1976.

   c. *American Enterprise Series: Innovation.* Color, 29 minutes, Modern Talking Picture Service, 1976.

   (NOTE: This series is available on a free-loan basis to Oklahoma instructors. Oklahoma instructors may order from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364. Out-of-state instructors must order from Modern Talking Picture Service, 45 Rockefeller Plaza, New York, New York 10020.)

C. Introduce unit to students.

- Discuss economics in general and relate the concept of supply and demand to real concerns of your students, such as buying a car, living on their own, the costs of clothes or dating.

- Play Monopoly or a similar game that uses free-enterprise theories, or use such games to illustrate concepts of the free-enterprise economy.

- Make a bulletin board display of magazine and newspaper reports on the economy and economic indicators.

  (NOTE: The National Federation of Independent Business prints a poster entitled "What's the Difference?" that compares the standards of living in Washington, D.C.; London, England; and Moscow, U.S.S.R. Copies are available free of charge to teachers ordering on school stationery from the National Federation of Independent Business, 150 West 20th Avenue, San Mateo, California 94403.)

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, emphasizing that a number of the students may become independent contractors and that all of them will act as producers and consumers throughout their adult lives.

- If possible, obtain construction-related statistics about job placement and the number of students who become independent contractors.

- Provide students with cost figures and other information regarding projects completed in your program in the past.

- Invite some independent contractors or construction company managers to discuss how their businesses are affected by free enterprise.

SUGGESTED ACTIVITIES

F. Provide students with information and assignment sheets.

G. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss terms associated with the free-enterprise system.

    - Use Supplement #1, "Free-Enterprise System Crossword Puzzle," to reinforce terms.

    - Have the students discuss the terms, using examples that they can relate to, such as their own personal property and competition on the football field or in completing a construction project.

2. Use Information Sheet, Sections II and III, to discuss the essential components and the functions of the free-enterprise economy.

    - Have students complete Assignment Sheet #1 to reinforce your discussion.

    - Relate the components and functions to games such as Monopoly.

3. Use Information Sheet, Sections IV and V, to discuss types of economic systems and the characteristics of a free-enterprise economy.

    - Use Transparency #1 to illustrate the characteristics of a free-enterprise system.

    - Have students complete Assignment Sheets #1 and #2 to reinforce their understanding of the characteristics of a free-enterprise economy.

    - Show film *American Enterprise Series: Land* to illustrate the concept of private property and to introduce the idea of supply.

    - Lead a group discussion to explore the history of a product with which the students are familiar to see how competition lowers prices and introduces improvements.

      EXAMPLES: Personal computers, video recorders, telephone service

    - Assign individuals or groups reports on the economic opportunities (or lack of opportunities) under other government systems.

SUGGESTED ACTIVITIES

4. Use Information Sheet, Section VI, to discuss goods, services, and resources in a free-enterprise economy.

   - Discuss various goods and services and relate them to consumer demand, comparing items that are essential to life (food, shelter, medical care, etc.) and those that are not essential (entertainment, luxury cars, cosmetic surgery, etc.).

5. Use Information Sheet, Sections VII and VIII, to discuss the roles of the producer and consumer within the free-enterprise functions of allocation, flow maintenance, and coordination.

   - Show the film *American Enterprise Series: Innovation.*

   - Provide the students with stories about successful entrepreneurs, especially those in real estate and construction.

   - Have the class discuss their own roles as producers and consumers.

   - Invite a local contractor or business person, or a group of such persons, to discuss work ethics, absenteeism, and other labor characteristics that impact upon production.

   - When discussing how producers raise the standard of living for consumers and how this has greatly increased the amount of leisure time, have the students think of time-saving products and services that are on the market now that were not on the market during their parents' or grandparents' lives. List their suggestions on the chalkboard.

     EXAMPLES: *Paper products*: Plates, tissues, diapers, napkins, bibs, etc.

     Disposable products: Syringes, thermometers, razor blades, lighters, etc.

     Services: Baby-sitting, housecleaning, painting, child-care centers

6. Use Information Sheet, Sections IX and X, to discuss how price is determined and how it influences flow in the free-enterprise system.

   - Have students complete Assignment Sheets #3 and #4 to reinforce these concepts.

SUGGESTED ACTIVITIES

- Have the students contact various specialty contractors such as electricians, plumbers, and materials suppliers to compare prices.

- Lead the class in a discussion of how price enters into their own buying decisions.

- Use trade magazines to determine construction costs per square foot in various sections of the country and to explore factors that may influence those costs, such as wages for construction workers, the costs of materials, and the overall cost of living in each area.

7. Use Information Sheet, Section XI, to discuss the role of the government in a free-enterprise system.

    - Show the film *American Enterprise Series: Government.*

    - Have the students complete Assignment Sheet #5 to reinforce this concept.

    - Provide students with documents that show the government in each of the roles described.

      EXAMPLES: Services provided by employment agencies and the Small Business Administration; consumer requirements as specified in government construction bid notices; regulations from OSHA and those in local building codes

    - Invite contractors and a government representative to discuss the roles of government in a free-enterprise system.

8. Use Information Sheet, Section XII, to discuss the economic goals of the American people.

    - Tie in the information from Section XI to introduce this material by defining the American enterprise system as a *modified free-enterprise system.* Explain how the various levels of government intervene in the economic process so that the system is not totally "free." Relate ways in which government regulations are often designed to promote the economic goals listed, such as ensuring efficiency, stability, and justice.

    - Have the class discuss the importance of these goals in their own lives.

SUGGESTED ACTIVITIES

H. Give test.

I. Critique test and discuss test in class.

J. Reteach if necessary.

K. Complete appropriate section of competency profiles.

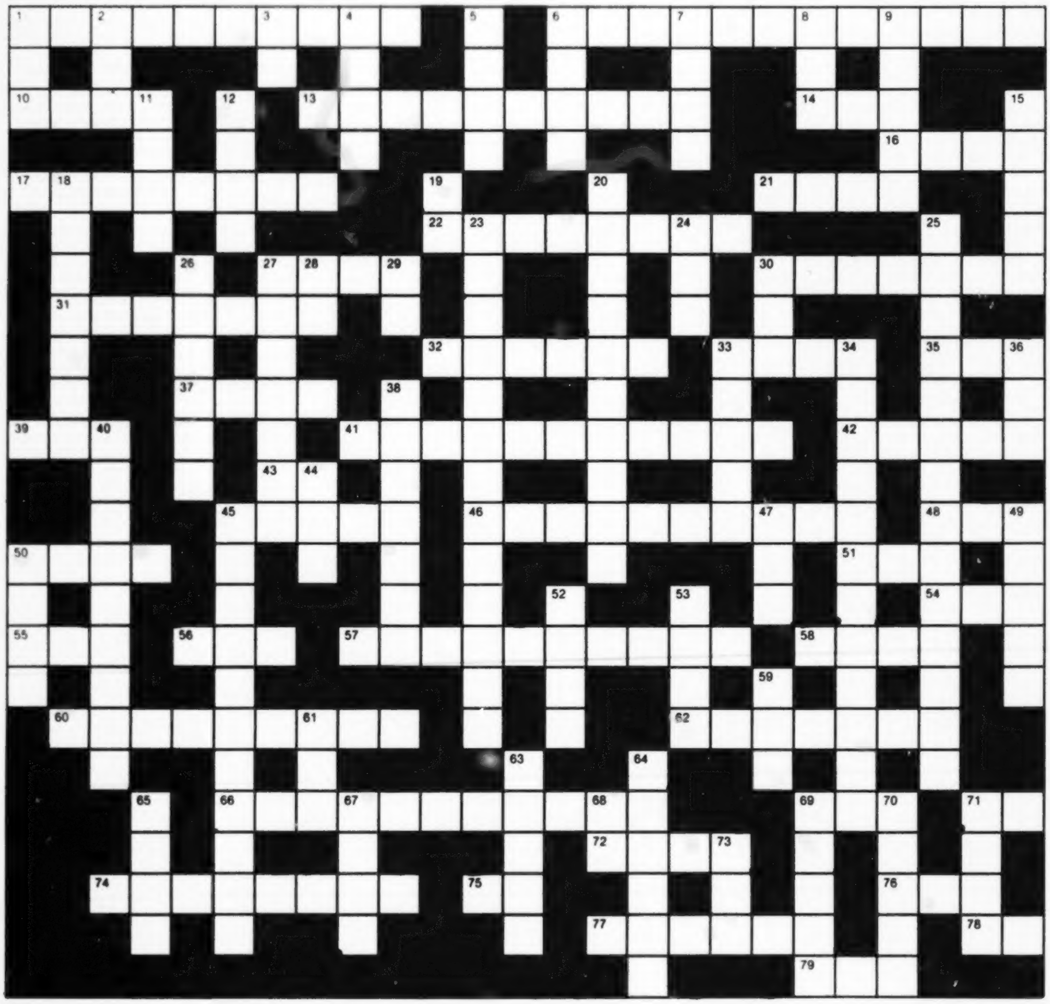
III. Unit reference

Hendrix, Laborn J. "Bud." *Fundamentals of Carpentry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1985.

FREE-ENTERPRISE SYSTEM
UNIT I

SUPPLEMENT #1 — FREE-ENTERPRISE SYSTEM CROSSWORD PUZZLE

Review your understanding of terms and definitions associated with a free-enterprise system by completing the crossword puzzle below. Clues and solution are on the following pages.



SUPPLEMENT #1

ACROSS

1. Benefit
6. Influence of group and individual decisions on economic system
10. Special offering of goods at prices lower than usual
13. Person or persons tasked with coordinating resources toward making a profit
14. Salary after taxes and deductions
16. Length times width
17. Work done or duties performed for another
21. Opposite of stockmarket "bear"
22. Labor, land, water, or fuel
27. Piece of metal used as money
30. Unfavorable or harmful
31. Type of resource
32. Money that a producer has left after selling goods or services and paying all expenses required for the production process
33. Federal Deposit Insurance Corporation (abbr)
35. Extrasensory perception (abbr)
37. Opposite of 54 across (abbr)
39. Big Apple (abbr)
41. Efforts made to attract consumers by two or more producers offering similar goods or services
42. Medium of exchange in the U.S.
43. Preposition
45. Exchanges
46. Undertaking or project; a business
48. Long, thin fish
50. Opposite of 32 across
51. Neither . . .
54. Property held by the government for use by all citizens (abbr)
55. Numeral (abbr)
56. Decision of a court or legislature; law, decree
57. Process of controlling, directing, or governing according to a rule, principle, or system
58. Two of a kind
60. Those who provide goods and services
62. Plural of 32 across
66. Type of economic system
69. Gross National Product (abbr)
71. Gram (abbr)
72. Periods
74. Distribute
75. Street (abbr)
76. International Trade Association (abbr)
77. Amount of a resource, good, or service that will be bought by consumers at a specific time for a given price
78. Pound (abbr)
79. To bring legal suit

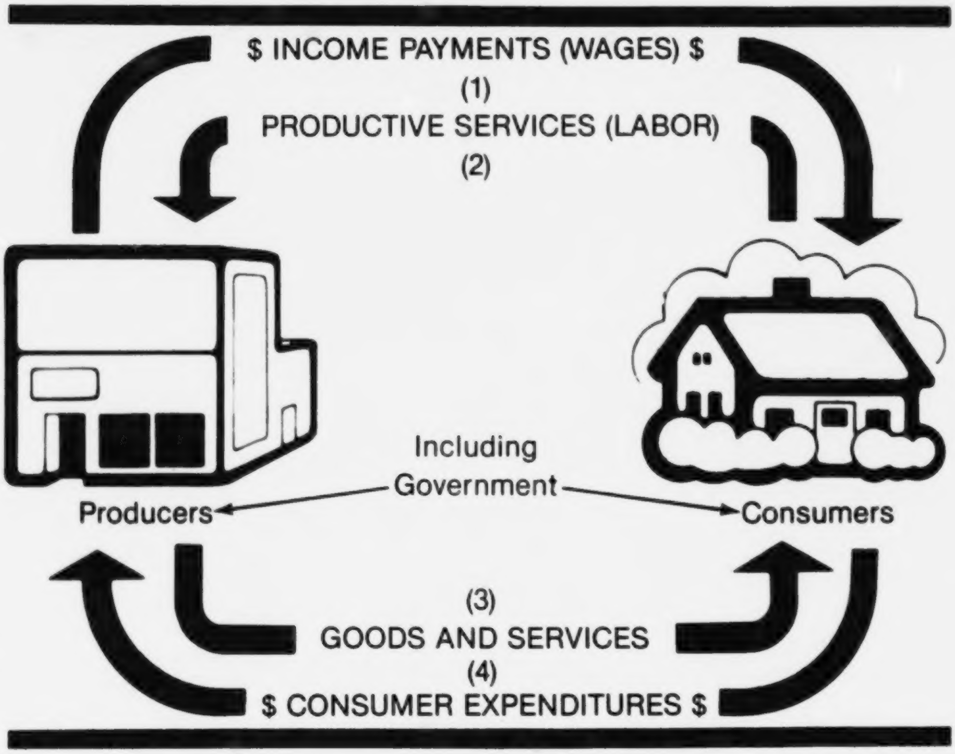
DOWN

1. Internal Revenue Service (abbr)
2. Dollar (abbr)
3. Money order (abbr)
4. Tidy
5. Money received in exchange for a service performed
6. Past tense of *come*
7. Fixed ratio or proportion; the - - - - of exchange
8. Prefix meaning *not*
9. Sum
11. Jealousy
12. Federal Insurance Contributions Act (abbr)
15. Worth of an item; price or cost
18. System of producing, distributing, and consuming wealth
19. Price (abbr)
20. Supports with a grant of money
23. Persons who organize and manage a business, assuming the risk of the business for the purpose of making a profit
24. Decrease in salary
25. Type of economic system that allows individual economic decisions (2 wds)
26. Amount of resource, good, or service that is available for exchange at a specific time for a given price
27. Wealth (money or property) used or capable of being used in production
28. Old Latin (abbr)
29. Negative answer
30. Addition (abbr)
33. That part of stock exchange upon which members stand
34. Anything given as an equivalent; payment for services
36. Take-home - - -
38. Use up products or services
40. Those who pay to receive goods and services
44. Total (abbr)
45. Continual and irregular change; up and down movement
47. Interest (abbr)
49. Physical and mental effort required to design, produce, and deliver goods and services
50. One of our natural resources
52. Money-lending institution
53. Corporation (abbr)
59. 2,000 pounds
61. Equal Rights Amendment (abbr)
63. Value or cost of items as determined by producers and consumers
64. Another name for directed economic system
65. Opposite of *buy*
67. Month, day, year
68. Advertisement (abbr)
69. Partner of 17 across
70. Value asked
71. Objective; aim
73. Small Business Association (abbr)

SOLUTION TO SUPPLEMENT #1

I	N	D	U	C	E	M	E	N	T	■	W	■	C	O	O	R	D	I	N	A	T	I	O	N
R	■	O	■	■	■	O	■	E	■	■	A	■	A	■	■	A	■	■	O	■	O	■	■	■
S	A	L	E	■	F	■	M	A	N	A	G	E	M	E	N	T	■	■	N	E	T	■	■	V
■	■	■	N	■	I	■	■	T	■	■	E	■	E	■	■	E	■	■	■	■	A	R	E	A
S	E	R	V	I	C	E	S	■	■	P	■	■	■	S	■	■	■	B	U	L	L	■	■	L
■	C	■	Y	■	A	■	■	■	■	R	E	S	O	U	R	C	E	■	■	■	■	F	■	U
■	O	■	■	S	■	C	O	I	N	■	N	■	■	B	■	U	■	A	D	V	E	R	S	E
■	N	A	T	U	R	A	L	■	O	■	T	■	■	S	■	T	■	D	■	■	■	E	■	■
■	O	■	■	P	■	P	■	■	■	P	R	O	F	I	T	■	F	D	I	C	■	E	S	P
■	M	■	■	P	R	I	V	■	C	■	E	■	■	D	■	■	L	■	■	O	■	E	■	A
N	Y	C	■	L	■	T	■	C	O	M	P	E	T	I	T	I	O	N	■	M	O	N	E	Y
■	■	O	■	Y	■	A	T	■	N	■	R	■	■	Z	■	■	O	■	■	P	■	T	■	■
■	■	N	■	■	F	L	O	W	S	■	E	N	T	E	R	P	R	I	S	E	■	E	E	L
L	O	S	S	■	L	■	T	■	U	■	N	■	■	S	■	■	■	N	■	N	O	R	■	A
A	■	U	■	■	U	■	■	■	M	■	E	■	B	■	■	C	■	T	■	S	■	P	U	B
N	U	M	■	A	C	T	■	R	E	G	U	L	A	T	I	O	N	■	P	A	I	R	■	O
D	■	E	■	■	T	■	■	■	■	■	R	■	N	■	■	R	■	T	■	T	■	I	■	R
■	P	R	O	D	U	C	E	R	S	■	S	■	K	■	■	P	R	O	F	I	T	S	■	■
■	■	S	■	■	A	■	R	■	■	■	■	W	■	■	C	■	■	N	■	O	■	E	■	■
■	■	■	S	■	T	R	A	D	I	T	I	O	N	A	L	■	■	■	G	N	P	■	G	M
■	■	■	E	■	I	■	■	A	■	■	■	R	■	D	O	T	S	■	O	■	R	■	O	■
■	■	A	L	L	O	C	A	T	E	■	S	T	■	■	S	■	B	■	O	■	I	T	A	■
■	■	■	L	■	N	■	■	E	■	■	■	H	■	D	E	M	A	N	D	■	C	■	L	B
■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	D	■	■	■	S	U	E	■	■	■

Free-Enterprise Flow Chart


$ INCOME PAYMENTS (WAGES) $
(1)
PRODUCTIVE SERVICES (LABOR)
(2)
Including
Government
Producers
Consumers
(3)
GOODS AND SERVICES
(4)
$ CONSUMER EXPENDITURES $

EXPLANATION

1. How production is shared — payment for resources (both labor and materials) according to how they satisfy consumer wants.
2. How to produce — the use of productive services (land, labor, capital, and management) in a production process to satisfy wants.
3. How much to produce — amount of goods and services produced as determined by consumer spending.
4. What to produce — the demand for goods and services as expressed by consumer spending.

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FREE-ENTERPRISE SYSTEM
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. **Enterprise** — Undertaking or project; a business

B. **Economic system** — Design, normally established by a government, to control the production, distribution, and consumption of goods and services

EXAMPLES: Free enterprise, closed, traditional

C. **Flow** — Exchange of goods and services for money

D. **Allocation** — Distribution

E. **Compensation** — Anything given as an equivalent; payment for services

F. **Labor** — Physical and mental effort required to design, produce, and deliver goods and services

G. **Natural resources** — Land, water, fuels, and raw materials required for production

H. **Capital** — Wealth (money or property) used or capable of being used in production

I. **Management** — Person or persons tasked with coordinating resources toward making a profit

J. **Regulation** — Process of controlling, directing, or governing according to a rule, principle, or system

K. **Entrepreneur** — Person who organizes and manages a business, assuming the risk of the business for the purpose of making a profit

L. **Economic value** — Worth of an item in satisfying the wants and needs of producers and consumers; price or cost

M. **Medium of exchange** — Anything used as a measure of value in exchange for goods and services

EXAMPLES: Currency, checks, services

N. **Supply** — Amount of a resource, good, or service that is available for exchange at a specific time for a given price

INFORMATION SHEET

O. **Demand** — Amount of a resource, good, or service that will be bought by consumers at a specific time for a given price

P. **Profit** — Money that a producer has left after selling goods or services and paying all expenses required in the production process

II. Components of an economic system

A. Goods and services — Material objects and assistances provided to satisfy the wants or needs of individuals who are willing to pay to obtain them

EXAMPLES: *Goods:* Food, clothing, housing, books, tools, lumber
Services: Cooking, tailoring, construction, printing, tool repair, equipment rental

B. Resources — Materials, facilities, planning, and organization required to produce and distribute goods and services

(NOTE: Resources are sometimes referred to as *factors of production*. Economists break resources into four categories: labor, land or natural resources, capital, and management.)

C. Producers — Those who provide goods and services

D. Consumers — Those who pay to receive goods and services

E. Regulating factors — Aspects of the economic system that determine allocation, flows, and coordination

(NOTE: A regulating factor may be part of the economic philosophy of the system, such as religious beliefs in a traditional system or freedom of choice in a free-enterprise system, or the regulation may be imposed by an individual or agency, such as a government in a closed system.)

F. Medium of exchange — Means used to provide compensation for resources or goods or services

(NOTE: The medium of exchange in an economic system is the basis for placing values on all that is bought and sold. Generally, a monetary system is established and used as the basis of relative values. This allows comparisons to be made, for example, between the value of a skilled carpenter's time and the value of a radial arm saw. However, exchanges may be made without a monetary system, either by comparing the value of two things directly or by using another standard such as gold.)

INFORMATION SHEET

III. Functions of an economic system

A. Resource allocation

B. Maintenance of flow

C. Coordination

(NOTE: Coordination is the influence on the economic system of group and individual decisions.)

IV. Types of economic systems

A. Traditional economy — Tradition, customs, and religious beliefs influence economic functioning; people are content to continue living as their parents and ancestors have

EXAMPLES: Isolated tribes of aborigines, island dwellers, inhabitants of remote mountainous areas

B. Closed (directed) economy — Economic functioning is controlled primarily by the decisions of an authoritative body or individual, usually the government

EXAMPLES: Communist countries such as the U.S.S.R., North Korea, People's Republic of China; socialist countries such as Great Britain, Spain, Italy

(NOTE: Political structures are often based on the economic philosophies of those who set up the government.)

C. Free-enterprise (market) economy — Economic decisions are made primarily by individuals who have the freedom to choose how they will spend their money, invest their time and energy, and set their economic goals

EXAMPLES: United States, Australia, Canada

(NOTE: These types of economic systems are broad categories that describe the basis for any actual system. It would be difficult to find any economic system in the world today that falls neatly into one category without exhibiting characteristics of the other types, especially at the national level. For example, although the United States operates under a primarily free-enterprise system, many of the economic decisions and goals of individuals are influenced by traditions and religious beliefs. Additionally, government control and regulation of some companies, such as utilities and defense contractors, resemble a closed economy.)

INFORMATION SHEET

V. Characteristics of a free-enterprise economy

A. Private property — That portion of personal income kept by the individual in the form of money, owned material goods, and investments such as stocks and bonds

(NOTE: In a free-enterprise system, the majority of property is privately owned, being held either by individuals or by individuals through private businesses. Some property, such as public schools, highways, national and state parks, is referred to as *public property* because it is held by the government for the use of all citizens. Under some economic systems there is little or no ownership on the part of private citizens.)

B. Freedom of choice — Right of consumers to spend their money as they desire and of producers to become involved in any legal business

(NOTE: Freedom of choice is essential in a free-enterprise economy. The choices made by consumers help to determine what producers will provide, how much of it will be provided, and the price at which it will be sold.)

C. Profit motivation — Desire of producers to increase their private-property holdings

(NOTE: The desire to make a profit leads entrepreneurs to establish businesses, which in turn creates jobs and provides additional or better goods and services.)

D. Competition — Efforts made to attract consumers by two or more producers offering similar goods or services

(NOTE: Competition between producers in a free-enterprise economy is a chief factor in the production of quality products at low prices. Competitors attempt to attract consumers by offering lower prices, added services or features, new or improved products, or by other means attractive to consumers.)

VI. Goods, services, and resources in a free-enterprise economy

A. Goods, services, and resources have an economic value

B. Economic value is usually stated in terms of the medium of exchange in the system

(NOTE: In the United States, the dollar is the basic monetary unit, and economic value is stated in terms of dollars. Thus, a new circular saw may be worth $150, and an hour of work from a frame carpenter may be worth $18.)

C. Exchanges (flows) of goods, services, and resources occur within the free-enterprise system

INFORMATION SHEET

D. Economic value is the basis for the exchanges made within the system

(NOTE: Individuals exchange their labor for money and then spend the money for goods and services. Thus, a resource is exchanged by a consumer for a good or service.)

E. Economic values rise and fall, depending on consumer demand and available supplies

(NOTE: Many variables enter into establishing the economic values of resources, goods, and services, with all such variables being interrelated and affected by one another. Two of the more important are *supply* and *demand*.)

VII. Producers in a free-enterprise economy

A. Allocation

1. Convert resources into goods and services that are wanted and needed by consumers

   EXAMPLE: Raw iron ore is converted to steel, which is then converted into automobiles.

2. Provide the management necessary to supply goods and services

B. Flows

1. Make consumers aware of new products, processes, and services; and provide a means of distribution of such items

2. Help to fund the cost of government

   (NOTE: Taxes paid by business and industry help to finance government agencies and programs, thus lowering the tax burden of individuals.)

C. Coordination

1. Perform tasks beyond the capabilities of most consumers

   EXAMPLE: A pharmaceutical company develops a vaccine for a disease.

2. Raise the standard of living for consumers

   (NOTE: The amount of leisure time and the ways of spending it have greatly increased over the years. This is largely because new products have become available or because people are able to purchase services that they formerly would have had to do themselves. Life for consumers is healthier and more rewarding because of the contributions made by producers.)

INFORMATION SHEET

3. Provide jobs

   (NOTE: Producers pay individuals for their time and skills. Additionally, many producers provide their workers with the facilities, equipment, and materials necessary to perform those jobs.)

VIII. Consumers in a free-enterprise economy

A. Allocation

1. Provide many of the natural resources and the labor used by producers
2. Make buying decisions that determine what is produced and how much is needed, thus influencing the use of resources

B. Flows

1. Make buying decisions that determine how much will be paid for goods and services
2. Make buying decisions that influence how much of a product is required and where it will be distributed

C. Coordination

1. Make buying decisions that help to set standards for industry

   EXAMPLE: Buyers expect a certain level of performance and dependability and certain standard features in the cars they purchase.

2. Affect the rate of growth in the economy through spending decisions and desires for goods and services

IX. Ways in which price is determined in a free-enterprise economy

A. Availability of resources

B. Collective buying decisions of consumers (demand)

EXAMPLE: Several years ago large American automobiles were selling better than small foreign automobiles. Today, consumers are purchasing more foreign automobiles. This demand has caused the price and supply of foreign automobiles to rise rapidly; the price of American automobiles has increased, but at a much slower rate.

C. Marketing surveys and reviews of past sales to determine what goods and services consumers will buy and at what price

INFORMATION SHEET

X. Ways in which price influences flow in a free-enterprise economy

A. Determines what will be produced by showing what goods and services are profitable

EXAMPLE: The selling price of sand is $3.75 per ton, and it costs the contractor $4.25 per ton to excavate; sand is not a profitable product for the contractor to sell.

B. Determines allocation of scarce resources

EXAMPLE: If diesel fuel is selling for $1.15 per gallon and kerosene is selling for $.90 per gallon, oil available to produce kerosene or diesel fuel will be used primarily to produce diesel fuel.

(NOTE: The producer will offer the product that will show the most profit.)

C. Determines methods of production for a good or service

EXAMPLE: If a home contractor can use a cheaper grade lumber to build a home and the consumer does not care, the contractor can reduce the cost of the product.

D. Determines what consumers are able to buy

EXAMPLE: If your income is $20,000 per year and you have no savings, you will not be able to buy a $250,000 home.

XI. Role of government in a free-enterprise economy

(NOTE: Everyone in a free-enterprise economy, including government, functions as both a consumer and producer. Government provides services such as postal and defense systems. It builds highways and public facilities. These activities and others require the use of resources. Additionally, government has a regulatory role in the economic system to ensure that economic goals are met and that producers and consumers can function with a degree of fairness in the marketplace.)

A. Resource allocation

1. Regulates use of resources

2. Legislates working conditions and wages

3. Imposes controls on some resources

EXAMPLES: Sets price for uranium ore, assists with education and training, regulates monopolies

INFORMATION SHEET

B. Flows

1. Subsidizes businesses that provide goods and services that might not be otherwise profitable

   EXAMPLES: Farming, railroads, airlines, manufacturers of defense products

2. Provides goods and services

3. Operates social programs

C. Coordination

1. Controls interest rates

2. Regulates international trade

3. Sets tax rates

4. Offers inducements for business expansion

5. Taxes at special rates some items considered to be luxuries

XII. Economic goals in a free-enterprise economy

(NOTE: One of the types of regulating factors in any economic system is the influence of traditions and social beliefs. In fact, these traditions and beliefs are largely responsible for determining what kind of system is in effect. Thus, the character of the citizenry influences a society's economic goals. The following is a list of the more important goals that influence allocation, flows, and coordination in a free-enterprise economy.)

A. Economic freedom — Right of producers and consumers to make economic decisions

B. Economic efficiency — Desire to use limited resources in the most productive and beneficial way

C. Economic growth — Desire for an ever-increasing standard of living

D. Economic stability — Freedom from major fluctuations in a nation's economy

EXAMPLES: Fluctuations include depressions and recessions; and great changes in interest rates, value of the monetary system, and employment rate.

INFORMATION SHEET

E. Economic justice — Fair distribution of society's resources and economic advantages

(NOTE: *Fair distribution* does not necessarily mean *equal* distribution. In a free-enterprise system, rewards go to those who have special skills, special knowledge, and greater abilities to contribute to the good of society. Thus, the more one produces for the good of society—as viewed by the society—the more one will obtain from the society.)

F. Economic security — Desire for a certain minimum standard of living for all members of the society

(NOTE: Social programs such as Medicare and urban renewal are attempts by the society to see that citizens who suffer hardship due to age, illness, unavoidable unemployment, economic fluctuations, and other adverse situations are not abandoned. Such efforts try to provide the disadvantaged with a share of the society's economic wealth.)

FREE-ENTERPRISE SYSTEM
UNIT I

ASSIGNMENT SHEET #1 — ANALYZE CHARACTERISTICS OF A FREE-ENTERPRISE ECONOMY

NAME ____________________ SCORE __________

The characteristics of a free-enterprise economy—private property, freedom of choice, profit motivation, and competition—are all interrelated. For example, a town may have only one roofing company that is able to handle the normal roofing needs. This company sets its prices high because of a lack of competition. Yet, after a hailstorm, the consumers' need for roofing increases, creating a larger market. As a result, roofing contractors from outside the town may send crews to the town to share in the potential profit caused by the expanded market. The original company will probably have to lower prices in order to compete.

Use your local telephone book to analyze the characteristics of a free-enterprise economy. This exercise will give you a good idea of how many businesses in your area are competing with each other for the consumers' dollars.

PART I

Use the Yellow Pages of your telephone book to determine the number of business firms competing for consumers' dollars for the following goods and services. Write the names of the companies or businesses in the blanks provided.

A. Equipment rentals

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________

B. Excavating companies

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________

ASSIGNMENT SHEET #1

C. Income-tax services

1. ______________________ 4. ______________________

2. ______________________ 5. ______________________

3. ______________________ 6. ______________________

D. Lumberyards

1. ______________________ 4. ______________________

2. ______________________ 5. ______________________

3. ______________________ 6. ______________________

E. Telephone companies

1. ______________________ 3. ______________________

2. ______________________ 4. ______________________

F. Hospitals (general medical and services)

1. ______________________ 3. ______________________

2. ______________________ 4. ______________________

PART II

Analyze the information collected in the survey to answer the following questions.

A. Which business appears to have the most competition for consumers' dollars? Explain your answer.

____

____

____

B. How do most firms demonstrate the free-market system?

____

____

____

ASSIGNMENT SHEET #1

C. What did the survey show you about profit motivation and business firms in your area?

____

____

____

D. What did the survey show about the use of private property by business?

____

____

____

PART III

Read the following case studies that demonstrate characteristics of the free-enterprise system at work. Write an "X" in the blanks before the characteristics you believe are at work, and explain your answers. More than one answer may be correct.

A. Jane Smith has $35,000 in savings and plans to use the money to start a cabinetmaking company. Jane conducted a survey of the people in the city in which she wants to locate the business. The survey shows a need for a cabinetmaking company, so Jane decides to open the business.

_____ 1. Private property

Why? ____

____

____

_____ 2. Freedom of choice

Why? ____

____

____

_____ 3. Profit motivation

Why? ____

____

____

ASSIGNMENT SHEET #1

______ 4. Competition

Why?____

____

____

B. John Jones owns and operates a power tools store. John employs four salespeople and a stock clerk. He has decided to change his business from a full-service to a self-service store in an effort to lower expenses and increase profits. The number of employees will be reduced to two, a cashier and a stock person.

______ 1. Private property

Why?____

____

____

______ 2. Freedom of choice

Why?____

____

____

______ 3. Profit motivation

Why?____

____

____

______ 4. Competition

Why?____

____

____

ASSIGNMENT SHEET #1

C. Pat James owns and operates a small brickyard. Pat has decided to increase the goods provided by the shop in an effort to offer items that the other brickyard in town does not carry. The goods that will be added are hand tools and equipment. Pat will have to borrow $10,000 from a relative to add these goods.

_____ 1. Private property

Why?____

____

____

_____ 2. Freedom of choice

Why?____

____

____

_____ 3. Profit motivation

Why?____

____

____

_____ 4. Competition

Why?____

____

____

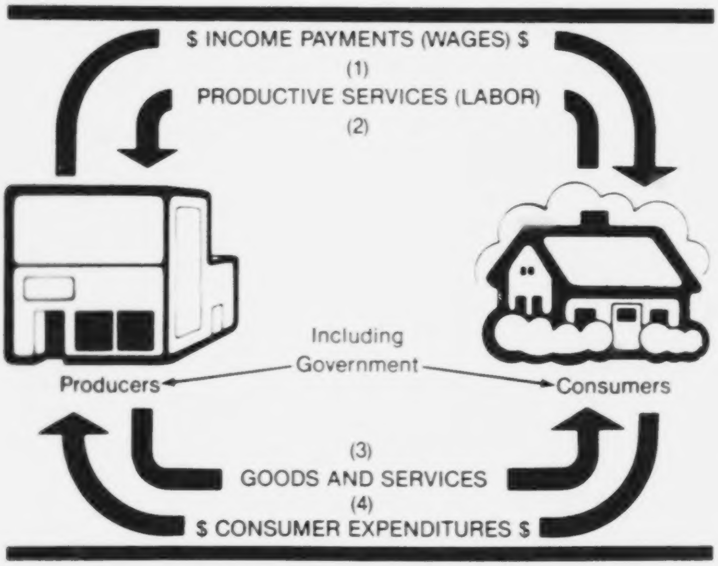
FREE-ENTERPRISE SYSTEM
UNIT I

ASSIGNMENT SHEET #2 — INTERPRET A FREE-ENTERPRISE FLOW CHART

NAME ____ SCORE ________________

One of the most important concepts to understand about the free-enterprise system is the constant exchange that goes on between producers and consumers, and how such flows affect supply and demand. Even if you never own your own business, you will be offering your skills and time as products for sale, with your wages being the payment for your product. Additionally, you will act as a consumer of goods and services provided by others.

Interpreting the following free-enterprise flow chart will help you understand how basic economic questions are determined in a free-enterprise economy.


$ INCOME PAYMENTS (WAGES) $
(1)
PRODUCTIVE SERVICES (LABOR)
(2)
Including
Government
Producers
Consumers
(3)
GOODS AND SERVICES
(4)
$ CONSUMER EXPENDITURES $

Adapted with permission of the South-Western Publishing Company, Cincinnati, Ohio, from *Free Enterprise in the United States*, by Eugene D. Wyllie and Roman F. Warmke, 1980.

How would the following changes within the free-enterprise economy normally affect flows in the system? Write an "X" in the blank before each correct answer.

A. If consumers' demand for goods and services increases, and the producer provides more goods and services, the producer's demand for productive services (land, labor, capital, and management) will

_____1. Increase _____2. Decrease _____3. Not change

ASSIGNMENT SHEET #2

B. If the producer demands more productive services and the consumers supply more, payment to consumers for productive services will

_____1. Increase _____2. Decrease _____3. Not change

C. If consumer expenditures for goods and services increase, the amount of goods and services produced will

_____1. Increase _____2. Decrease _____3. Not change

D. If the producer pays less for productive services, the amount paid by consumers for goods and services should

_____1. Increase _____2. Decrease _____3. Not change

E. If the producer produces fewer goods and services and consumer expenditures indicate a demand for equally fewer goods and services, the cost paid by consumers for goods and services should

_____1. Increase _____2. Decrease _____3. Not change

F. If consumers provide more productive services while the producer's demands for productive services remain the same, the amount the producer pays for productive services should

_____1. Increase _____2. Decrease _____3. Not change

FREE-ENTERPRISE SYSTEM
UNIT I

ASSIGNMENT SHEET #3 — INTERPRET PRICE INFLUENCES IN A FREE-ENTERPRISE ECONOMY

NAME ____________________ SCORE __________

One of the major considerations experts use to analyze the economy is the number of new home starts and building permits issued. Our country's economy is closely tied to the state of the construction trades. As you become involved in this field, you will grow more aware of your role in influencing the economy and, in turn, more aware of how your business and standard of living are influenced by the economy.

Interpreting the following case studies will help you examine some of the relationships in a free-enterprise economy. Refer to Information Sheet, Section X, as needed.

A. The Bryan Construction Company is planning to add one more floor plan to its housing development series. The company is considering two floor plans. The company estimates that they can sell ten houses of floor plan A at a profit of $14,000 each; or they can sell twelve houses using floor plan B, at a profit of $11,500 each.

Which floor plan should the company select to sell? Explain.

B. John and Susan Johnson are planning to buy a new location for their tool business. They have looked at two locations that they like. The locations are basically the same, except that location A includes 5 acres of land, and location B is a 100-foot lot. The monthly payments on location A are $1500, and the payments on location B are $1300. Based on their monthly income and their other financial obligations, the Johnsons decided that they could not afford location A.

What economic factor lead to the Johnsons' decision? Explain.

ASSIGNMENT SHEET #3

C. A few years ago, there was a shortage of coffee in the United States. Because of this shortage, the coffee companies raised prices. Consumers objected to the price increase and began using less coffee. The decrease in the use of coffee affected the coffee companies' profits to the point that they decided to lower prices to a more reasonable level.

Explain this supply and demand cycle in terms of consumer/producer relationships.

D. The Miller Building Materials Company has decided to conduct a marketing survey and to review the previous year's sales records for asphalt shingles. The purpose of the survey and review is to determine the style of shingles the consumers will buy and the price that the consumers will pay.

What consumer/producer relationships may have influenced Miller's decision to conduct a survey and review sales records? Explain.

FREE-ENTERPRISE SYSTEM
UNIT I

ASSIGNMENT SHEET #4 — COLLECT INFORMATION ON THE ROLE OF GOVERNMENT IN A FREE-ENTERPRISE ECONOMY

NAME ______________________________ SCORE ______________

One of the largest influences on the free enterprise system is the role of the various levels of government as consumer, producer, and regulator. You will find that every phase of construction is used to meet the consumer needs of government, and that numerous government agencies and regulations apply specifically to the carpentry trade. This assignment sheet will help you become familiar with some of the roles played by government in your trade.

PART I

Interview or contact by letter at least one agency from each of the following levels of government to determine the functions the agency performs and to see how government acts as a producer and regulator. Use the questions included in this assignment sheet to complete the interviews.

A. Federal

EXAMPLES: Federal Trade Commission
Food and Drug Administration
U.S. Postal Service
OSHA (Occupational Safety and Health Administration)
Department of Labor-Wage and Hour Administration
Social Security Administration

1. Name of agency ______________________________

2. With what type of business does the agency work? ______________________________

____

____

____

____

3. What goods or services does the agency provide to these businesses?

____

____

____

ASSIGNMENT SHEET #4

4. What regulatory or protective functions are performed for these businesses?

B. State

EXAMPLES:	Department of Human Services (welfare office) State Employment Office State Highway Department State Department of Health Department of Consumer Affairs Corporation Commission

1. Name of agency ____________________

2. With what type of business does the agency work? ____________________

3. What goods or services does the agency provide to these businesses?

4. What regulatory or protective functions are performed for these businesses?

ASSIGNMENT SHEET #4

C. County or City

EXAMPLES: Board of County Commissioners
County Clerk
County Tax Assessor
County Surveyor
Highway Inspector
Buildings and Codes Department
City Engineer

1. Name of agency ______________________________

2. With what type of business does the agency work? ______________________________

3. What goods or services does the agency provide to these businesses?

4. What regulatory or protective functions are performed for these businesses?

ASSIGNMENT SHEET #4

PART II

Government agencies also serve as consumers. Contact one of the companies listed below to determine how government relates to that business as a producer, regulator, and consumer.

EXAMPLES:
- Bank or savings and loan company
- Excavating contractor
- Building contractor
- Day-care center
- Telephone company
- Gas company or electric company
- Hospital or nursing home
- Demolition contractor
- Manufacturing business

Type of business____________________

Name of business____________________

A. What goods or services are provided for the business by the following levels of government?

1. Federal — ____________________

2. State — ____________________

3. County or city — ____________________

ASSIGNMENT SHEET #4

B. How is this business affected by the regulatory functions performed by the following levels of government?

1. Federal — ______________________________

2. State — ______________________________

3. County or city — ______________________________

C. What services or products does the company provide to each level of government?

1. Federal — ______________________________

2. State — ______________________________

3. County or city — ______________________________

FREE-ENTERPRISE SYSTEM
UNIT I

ASSIGNMENT SHEET #5 — ANALYZE SUPPLY AND DEMAND

NAME ______________________________ SCORE ______________

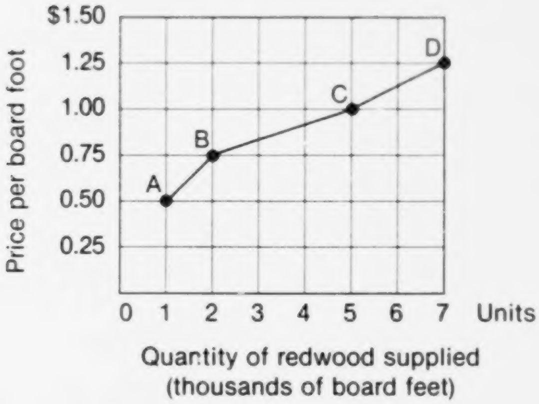
Construction workers quickly learn how many buying decisions are required in the trade, especially for tools and materials. Prices for such purchases result from the principles of supply and demand. Analyzing the case study in this assignment sheet will help you develop a better understanding of the relationship between supply and demand.

Two ways of comparing supply and demand are supply and demand schedules and supply and demand curves. Read through the following schedules (Tables 1 through 3) and curves, and then complete this assignment sheet by analyzing the case study given and the supply and demand schedule in Table 4.

TABLE 1—Redwood supply schedule

Price (per board foot)	Quantity (board feet)	Point on supply curve
$0.50	1,000	A
0.75	2,000	B
1.00	5,000	C
1.25	7,000	D

Supply curve



1. Price is always shown on the vertical axis
2. Quantity is always shown on the horizontal axis
3. Points on the supply curve are located by use of a supply schedule
4. Supply is normally graphed as an upsloping line because more is produced as price goes up

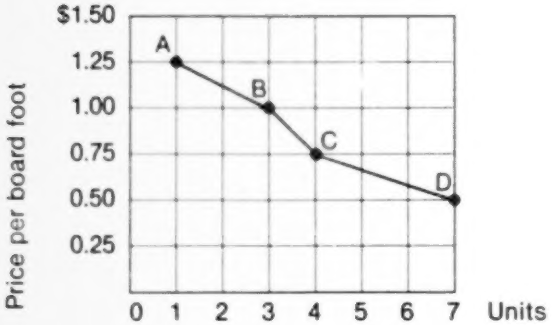
ASSIGNMENT SHEET #5

TABLE 2

Redwood demand schedule

Price (per board foot)	Quantity (board feet)	Point on demand curve
$1.25	1,000	A
1.00	3,000	B
0.75	4,000	C
0.50	7,000	D

Demand curve



Quantity of redwood demanded
(thousands of board feet)

1. Price is always shown on the vertical axis

2. Quantity is always shown on the horizontal axis

3. Points on the demand curve are located by use of a demand schedule

4. Demand is normally graphed as a downsloping line because more is purchased as price goes down

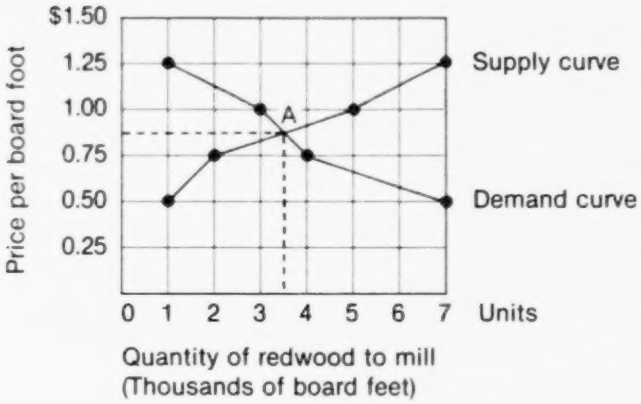
ASSIGNMENT SHEET #5

TABLE 3

Redwood supply and demand schedule

Price (per board foot)	Quantity supplied (board feet)	Quantity demanded (board feet)
$0.50	1,000	7,000
0.75	2,000	4,000
1.00	5,000	3,000
1.25	7,000	1,000

Supply and demand curve



The point where the supply curve crosses the demand curve indicates the ideal amount of redwood to mill and the price to charge for each board foot.

A. The Fast-Cut Saw Company has conducted a survey to determine the number of saws to produce and the price to charge. The results of the survey have been placed in the supply and demand schedule on the next page (See Table 4)

ASSIGNMENT SHEET #5

TABLE 4

Saws supply and demand schedule

Price	Number supplied	Number demanded
$ 75.00	300,000	1,000,000
100.00	500,000	900,000
125.00	650,000	850,000
150.00	700,000	800,000
175.00	800,000	700,000
200.00	950,000	600,000
225.00	1,000,000	400,000

1. Construct a supply curve using the information in Table 4.

ASSIGNMENT SHEET #5

2. Construct a demand curve using the information in Table 4.

3. Construct a supply and demand curve using the information in Table 4.

B. Analyze your supply and demand curve to answer the following questions.

1. How many saws should be produced? ____________________
2. What price should be charged for each saw? ____________________

FREE-ENTERPRISE SYSTEM
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Parts I and II evaluated to the satisfaction of the instructor

Part III

A. (2) Freedom of choice — As a producer Jane is free to choose a business to operate

(3) Profit motivation — Jane's survey determined the need for a cabinetmaking company in that city; Jane's decision to start the company is based on her desire to make money and the fact that the survey indicates that she should be able to.

(NOTE: Students may list private property as another characteristic at work. There is some basis for this conclusion, but the instructor should use such a situation as an opportunity to explain how Jane's investment of private property also functions as the use of resources by her company.)

B. (3) Profit motivation — John has taken steps to reduce his expenses in order to increase profits

(NOTE: Profit motivation is the primary characteristic at work here. A student may justify to some extent that John has exercised freedom of choice in changing the business. Although competition may make it necessary for John to take this action, that cannot be determined from the information given.)

C. (1) Private property — The investment of $10,000 by Pat's relative represents the use of private property in the free-enterprise system

(4) Competition — Pat's decision to offer the additional goods is an attempt to make the brickyard more attractive to consumers by providing goods not offered by Pat's competitor

(NOTE: Again, freedom of choice and profit motivation are also at work, but the primary principles illustrated in this case are private property and competition.)

Assignment Sheet #2

A. 1
B. 1
C. 1
D. 2
E. 3
F. 2

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #3

A. Plan A; the profit from the sale of Plan A equals $140,000, and the profit from the sale of Plan B equals $138,000. The sale of Plan A would result in an additional $2,000 profit; the price of goods and services determines what will be produced by showing what goods and services are profitable

B. The price of goods and services determines what consumers are able to buy

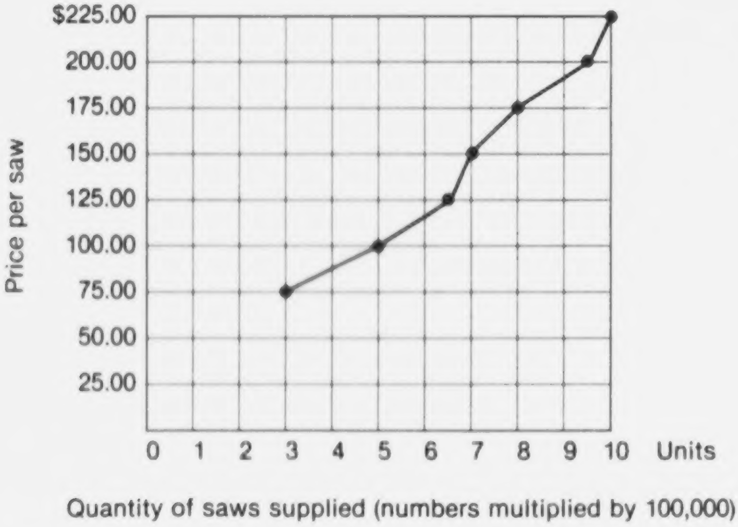
C. The collective buying decisions of consumers determines the price for goods and services

D. Business and industry conduct marketing surveys and review past sales records in an effort to determine what goods and services consumers will buy and what price consumers will pay

Assignment Sheet #4 — Evaluated to the satisfaction of the instructor

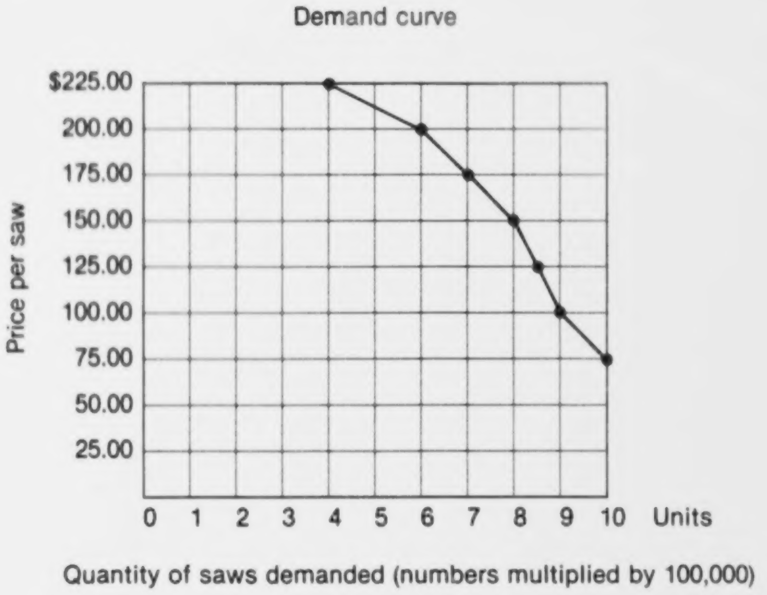
Assignment Sheet #5

A. 1. Supply curve

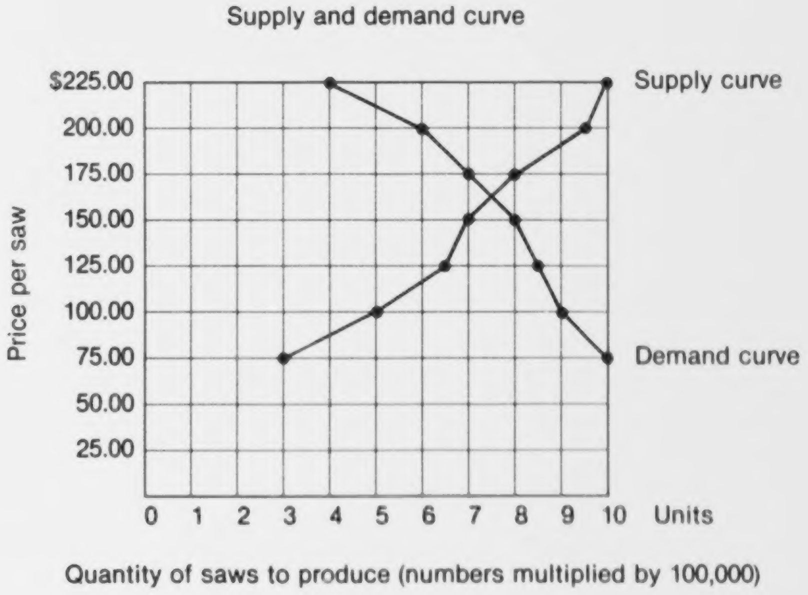


ANSWERS TO ASSIGNMENT SHEETS

2.



3.



B. 1. 750,000 saws
   2. $162.50

FREE-ENTERPRISE SYSTEM
UNIT I

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with the free-enterprise system. Write the correct numbers in the blanks. Definitions are continued on the next page.

______a. Exchange of goods and services for money

______b. Distribution

______c. Amount of a resource, good, or service that will be bought by consumers at a specific time for a given price

______d. Anything used as a measure of value in exchange for goods and services

______e. Worth of an item in supplying the wants and needs of producers and consumers; price or cost

______f. Process of controlling, directing, or governing according to a rule, principle, or system

______g. Wealth (money or property) used or capable of being used in production

______h. Physical and mental effort required to design, produce, and deliver goods and services

______i. Amount of a resource, good, or service that is available for exchange at a specific time for a given price

______j. Undertaking or project; a business

______k. Anything given as an equivalent; payment for services

______l. Land, water, fuels, and raw materials required for production

______m. Person or persons tasked with coordinating resources toward making a profit

______n. Person who organizes and manages a business, assuming the risk of the business for the purpose of making a profit

1. Enterprise
2. Economic system
3. Compensation
4. Labor
5. Natural resources
6. Flow
7. Profit
8. Medium of exchange
9. Demand
10. Economic value
11. Regulation
12. Capital
13. Management
14. Entrepreneur
15. Allocation
16. Supply

TEST

______o. Design, normally established by a government, to control the production, distribution, and consumption of goods and services

______p. Money that a producer has left after selling goods or services and paying all expenses required in the production process

2. Match components of an economic system to their correct descriptions. Write the correct numbers in the blanks.

______a. Those who provide goods and services

______b. Materials, facilities, planning, and organization required to produce and distribute goods and services

______c. Aspects of the economic system that determine allocation, flows, and coordination

______d. Those who pay to receive goods and services

______e. Means used to provide compensation for resources or goods or services

______f. Material objects and assistances provided to satisfy the wants or needs of individuals who are willing to pay to obtain them

1. Goods and services
2. Consumers
3. Producers
4. Resources
5. Medium of exchange
6. Regulating factors

3. List the functions of an economic system.

a. ______________________________

b. ______________________________

c. ______________________________

4. Match the following types of economic systems to their correct descriptions. Write the correct numbers in the blanks.

______a. Economic functioning is controlled primarily by the decisions of an authoritative body or individual, usually the government

______b. Economic decisions are made primarily by individuals who have the freedom to choose how they will spend their money, invest their time and energy, and set their economic goals

______c. Tradition, customs, and religious beliefs influence economic functioning; people are content to continue living as their parents and ancestors have

1. Traditional economy
2. Closed (directed) economy
3. Free-enterprise (market) economy

TEST

5. Describe characteristics of a free-enterprise economy.

   a. Private property — ______________________________

   b. Freedom of choice — ______________________________

   c. Profit motivation — ______________________________

   d. Competition — ______________________________

6. State four facts about goods, services, and resources in a free-enterprise economy.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

TEST

7. Select from the following list facts about producers in a free-enterprise economy. Write an "X" in the blank before each correct answer.

   ______a. Convert resources into goods and services without consideration of consumer desires

   ______b. Provide jobs

   ______c. Help to fund the cost of government

   ______d. Perform tasks beyond the capabilities of most consumers

   ______e. Lower the standard of living for consumers

   ______f. Provide the management necessary to supply goods and services

   ______g. Make consumers aware of new products, processes, and services; and provide a means of distribution of such items

8. Select from the following list facts about consumers in a free-enterprise economy. Write an "X" in the blank before each correct answer.

   ______a. Provide many of the natural resources and the labor used by producers

   ______b. Make buying decisions that determine what is produced and how much is needed, thus influencing the use of resources

   ______c. Make buying decisions that determine how much will be paid for goods and services

   ______d. Make buying decisions that influence how much of a product is required and where it will be distributed

   ______e. Provide jobs

   ______f. Provide the management necessary to supply goods and services

   ______g. Make buying decisions that help set the standards for industry

   ______h. Affect the rate of growth in the economy through spending decisions and desires for goods and services

9. List ways in which price is determined in a free-enterprise economy.

   a. ____

   b. ____

   c. ____

TEST

10. Select from the following list ways in which price influences flow in a free-enterprise economy. Write an "X" in the blank before each correct answer.

______a. Determines what will be produced by showing what goods and services are profitable

______b. Determines quality of goods and services

______c. Determines methods of production for a good or service

______d. Determines allocation of scarce resources

______e. Determines what consumers are able to buy

11. Discuss the role of government in a free-enterprise system.

a. Resource allocation — ______________________________

____

____

____

b. Flows — ______________________________

____

____

____

c. Coordination — ______________________________

____

____

____

____

____

____

TEST

12. Match to their correct descriptions economic goals in a free-enterprise system. Write the correct numbers in the blanks.

_____a. Desire for an ever-increasing standard of living

_____b. Desire for a certain minimum standard of living for all members of the society

_____c. Right of producers and consumers to make economic decisions

_____d. Desire to use limited resources in the most productive and beneficial way

_____e. Fair distribution of society's resources and economic advantages

_____f. Freedom from major fluctuations in a nation's economy

1. Economic freedom
2. Economic efficiency
3. Economic growth
4. Economic stability
5. Economic justice
6. Economic security

(NOTE: Test question 13 lists an assignment sheet. It is considered an important part of this test. If it has not been completed, check with your instructor.)

13. Analyze supply and demand.

FREE-ENTERPRISE SYSTEM
UNIT I

ANSWERS TO TEST

1. a. 6
   b. 15
   c. 9
   d. 8
   e. 10
   f. 11
   g. 12
   h. 4
   i. 16
   j. 1
   k. 3
   l. 5
   m. 13
   n. 14
   o. 2
   p. 7

2. a. 3
   b. 4
   c. 6
   d. 2
   e. 5
   f. 1

3. a. Resource allocation
   b. Maintenance of flow
   c. Coordination

4. a. 2
   b. 3
   c. 1

5. Description should include the following

   a. Private property — That portion of personal income kept by the individual in the form of money, owned material goods, and investments such as stocks and bonds
   b. Freedom of choice — Right of consumers to spend their money as they desire and of producers to become involved in any legal business
   c. Profit motivation — Desire of producers to increase their private-property holdings
   d. Competition — Efforts made to attract consumers by two or more producers offering similar goods or services

6. Answer should include any four of the following

   a. Goods, services, and resources have an economic value
   b. Economic value is usually stated in terms of the medium of exchange in the system
   c. Exchanges (flows) of goods, services, and resources occur within the free-enterprise system
   d. Economic value is the basis for the exchanges made within the system
   e. Economic values rise and fall, depending on consumer demand and available supplies

7. b, c, d, f, g

8. a, b, c, d, g, h

ANSWERS TO TEST

9. a. Availability of resources
   b. Collective buying decisions of consumers (demand)
   c. Marketing surveys and reviews of past sales to determine what goods and services consumers will buy and at what price

10. a, c, d, e

11. Discussion should include the following

    a. Resource allocation — Regulates use of resources; legislates working conditions and wages; imposes controls on some resources
    b. Flows — Subsidizes businesses that provide goods and services that might not otherwise be profitable; provides goods and services; operates social programs
    c. Coordination — Controls interest rates; regulates international trade; sets tax rates; offers inducements for business expansion; taxes at special rates some items considered to be luxuries

12. a. 3
    b. 6
    c. 1
    d. 2
    e. 5
    f. 4

13. Evaluated to the satisfaction of the instructor

AMERICA'S INFRASTRUCTURE
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss the nation's infrastructure system and interpret how this infrastructure will affect the nation's construction industry in the future. The student will show this ability by completing the assignment sheet and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Define *infrastructure.*
2. Name categories of infrastructures.
3. Select from a list the purposes of an infrastructure.
4. Discuss the present condition of the nation's infrastructure.

AMERICA'S INFRASTRUCTURE
UNIT II

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplement #1 — Executive Preview of America's Infrastructure

   D. Information sheet

   E. Assignment Sheet #1 — Conduct a Survey of Specific Infrastructure Repair Needs in Your Community

   F. Answers to assignment sheet

   G. Test

   H. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain videotapes to supplement unit.

   (NOTE: The following videotapes are available to Oklahoma teachers on a free-loan basis from the Oklahoma State Department of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364. Out-of-state teachers should contact the nearest AGC chapter or the national office.)

      1. "Building — Our Vertical Infrastructure." Color, videotape on $^{1}/_{2}$- or $^{3}/_{4}$-inch VHS cassette.

      2. "AGC Infrastructure Medley 2." Color, videotape on $^{1}/_{2}$- or $^{3}/_{4}$-inch VHS cassette.

      3. *"The Infrastructure: An American Crisis."* Teacher's guide with activity sheets, filmstrip, audiotape and poster.

   C. Introduce unit to students.

   - Use information from Supplement #1 or provide the supplement to the students as a handout for discussion.

   - Introduce the students to The Associated General Contractors of America (AGC) and other such groups.

SUGGESTED ACTIVITIES

- Invite an AGC representative or other person familiar with the infrastructure concept to talk to the class, emphasizing aspects of the infrastructure in your area.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, emphasizing how the infrastructure impacts on the construction industry.

F. Provide students with information and assignment sheets.

G. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to broaden your explanation of infrastructure.

    - Show the videotapes to illustrate the concept of infrastructure and to introduce the next section of the information sheet.

    - Relate the idea of the infrastructure to production and consumerism as discussed in Unit I, "The Free Enterprise System," emphasizing the role of government and the nation's economic goals.

2. Use Information Sheet, Section II, to discuss categories of infrastructures.

    - Relate the examples in this section and your own examples to the ideas of essential services and sustaining the standard of living.

    - Have the class identify and list specific buildings and structures in the community to illustrate the examples.

    (NOTE: You may want to save the list for use with Assignment Sheet #1 in conjunction with Objective 4.)

3. Use Information Sheet, Section III, to discuss the purposes of an infrastructure.

    - Relate the various infrastructures to their purposes.

    - Have the students list specific ways in which the purposes outlined in Section III are met.

4. Introduce Information Sheet, Section IV, by discussing the consequences of having an infrastructure that is unable to fulfill the stated purposes. Discuss the condition of the nation's infrastructure.

    - Use Table 1 to discuss needed infrastructure repairs, updating the information if possible.

    - Acquaint students with specific repair needs in your area by having them complete Assignment Sheet #1.

SUGGESTED ACTIVITIES

- Have the students find and bring to class local newspaper articles dealing with infrastructure repair needs. Make a bulletin board display.
- Discuss what the condition of the infrastructure means in terms of jobs and job opportunities to the construction trades.

H. Collect photographs of infrastructure repair needs in your area. Encourage the class to undertake a project to do something about these needs, such as making the public aware of the conditions, or offering their services to local agencies to assist in repairing the infrastructure.

I. Give test.

J. Reteach and retest as necessary.

K. Complete appropriate section of competency profiles.

(NOTE: Competency profiles are available from AGC and CIMC.)

III. Unit reference — "Infra-Structure." *Constructor,* Vol. LXV, No. 5 (May, 1983).

AMERICA'S INFRASTRUCTURE
UNIT II

SUPPLEMENT #1 — EXECUTIVE PREVIEW OF AMERICA'S INFRASTRUCTURE

The nation's infrastructure is its system of public facilities, both publicly and privately funded, which provides for the delivery of essential services and a sustained standard of living. This interdependent, yet self-contained, set of structures provides for our mobility, shelter, services, and utilities. It is the nation's highways, bridges, railroads, and mass transit systems. It is our sewers, sewage treatment plants, water supply systems, and reservoirs. It is our dams, locks, waterways, and ports. It is our electric, gas, and power-producing plants. It is our courthouse, jails, firehouses, police stations, schools, post offices, and government buildings.

America's infrastructure is the base upon which society rests. Its condition affects our lifestyles and security, and each is threatened by its unanswered decay.

America has no acceptable alternative to urgently developing a program to rebuild the nation's public facilities, the skeleton of public works that provides society's basic and supporting services.

The almost daily casualty list of failing public facilities includes highways, bridges, water supply systems, sewage treatment plants, pipelines, and dams. But beyond that, the victims of neglect include schools, utilities, parks, hospitals, libraries, firehouses, and jails. These facilities and services touch every aspect of everyone's life.

The presently identifiable program cost to meet presently identified needs is approximately $3 trillion, according to estimates compiled by The Associated General Contractors of America (AGC).

There can be no question about the national urgency. The problems are not merely serious. Many are beyond the point where deterioration begins to accelerate at alarming rates and the hazards begin to compound themselves. The percentages of facilities in serious decay suggest the brutal reality:

- Nearly half of the nation's bridges are too weak to adequately handle the traffic loads.
- Almost one of every two paved miles of roads needs to be resurfaced or completely rebuilt.
- About 13 percent of the country's aging dams are classified as "high hazard."
- America's railroads must replace half of their ties over the next five years.
- Nearly half of the nation's sewage treatment plants are preventing economic growth because of inadequate capacity.
- Municipal water systems throughout the country are collapsing, threatening the quality of the water people consume, or failing to keep up with demand.

SUPPLEMENT #1

While the cost of repairs is great, there is no alternative, and the cost of delay is too high. The alternative to meeting the challenge is a continued and rapidly increasing deterioration in the nation's economic base, in the quality of life, and in the public's health. The General Accounting Office, for example, sees drinking water contamination "emerging as one of the most serious health and environmental problems facing our nation during the '80s and '90s."

A public facilities renewal program will also provide immense benefit to the economy and increased employment. Unemployment, which has weakened the nation's workforce, has hit nearly one million persons in the construction industry, about one out of every five. Each $1 billion spent on construction creates tens of thousands of on-site jobs and has a multiplier effect in related industries and fields that benefit from construction spending. For example, $1 billion spent on rebuilding our nation's highways would generate 13,100 on-site jobs and 63,000 jobs overall.

The complexity and scope of the nation's crumbling public facilities are a crisis and an opportunity. The crisis, as it becomes increasingly clear, threatens in very direct ways the nation's health, its safety, its economy, its workers, and its ability to meet the needs of today and tomorrow.

The opportunity is equally clear. It is to revitalize the national delivery of the vital services its citizens demand and to put them on a sounder financial base.

The needs could not be clearer, or more immediate. The price of delaying the task increases the ultimate cost to everyone.

Source: "AGC/CIMC Instructional Systems and Executive Preview" by AGC Training Coordinator, p. 3.

AMERICA'S INFRASTRUCTURE
UNIT II

INFORMATION SHEET

I. Definition of *infrastructure*

Infrastructure -- System of public and private facilities that provides for delivery of essential services to sustain a minimum standard of living

II. General categories of infrastructures

A. Building infrastructures

EXAMPLES: Housing; hospitals; schools; prisons; police and fire stations; libraries; museums; storage buildings; stadiums; courthouses; federal, state, and local offices

B. Municipal utilities infrastructures

EXAMPLES: Potable water systems, wastewater treatment plants, drainage systems, flood-control systems, curbs, gutters, sidewalks

C. Heavy industrial infrastructures

EXAMPLES: Locks, ports, waterways, dams, reservoirs, railroads, mass transit systems

D. Highway infrastructures

EXAMPLES: Highways, bridges, airports

III. Purposes of the infrastructure

A. To promote public health and safety

B. To provide transportation of goods and services

C. To aid in national defense

D. To improve quality of life and standard of living

E. To strengthen national economy

F. To produce energy

INFORMATION SHEET

IV. Present condition of the nation's infrastructure

A. The nation's infrastructure is greatly deteriorated and in need of immediate costly repairs (Table 1)

EXAMPLE:

TABLE 1: National infrastructure needs (in billions)

Identified need	Cost
Highways	$1570.3
Wastewater treatment	507.8
Drainage, minor flood control	169.4
Potable water (urban)	138.6
Hospitals	130.0
Housing (multifamily and low-income)	112.0
Dams/reservoirs	83.5
Airports	60.3
Railroads	60.1
Bridges	51.7
Educational facilities	49.0
Mass transit	37.2
Waterways	32.5
Locks	15.0
Prisons	7.0
Ports	3.7
Post offices	3.0
TOTAL	$3031.1

Adapted with permission of The Associated General Contractors of America, Washington, D.C., from "Infra-structure," *Constructor*, Vol. LXV, No. 5, May, 1983, p. 37.

INFORMATION SHEET

B. Repair and maintenance of the infrastructure will stimulate the economy by producing jobs (Table 2)

(NOTE: Labor requirements vividly illustrate how infrastructure repair and maintenance will affect job opportunities in future years. The Bureau of Labor Statistics estimates that 2.4 million additional workers will be required by 1990. Presently, existing training programs can be expected to provide only about 600,000 workers, leaving a shortage of 1.8 million skilled workers by 1990.)

EXAMPLE:

TABLE 2: New workers needed yearly

Worker	Number
Laborers	49,000
Highway construction workers	38,000
Equipment operators	36,000
Bricklayers	24,000
Plumbers and pipefitters	20,000

AMERICA'S INFRASTRUCTURE
UNIT II

ASSIGNMENT SHEET #1 — CONDUCT A SURVEY OF SPECIFIC INFRASTRUCTURE REPAIR NEEDS IN YOUR COMMUNITY

NAME ______________________________ SCORE ______________

The need for infrastructure rebuilding and maintenance is evident in many of the nation's communities. Often, these needs go unnoticed by the general public. Conduct a survey of local building, municipal, heavy industrial, and highway infrastructure facilities in your community.

Building infrastructure

Location ______________________________

Specific need ______________________________

____

____

Municipal infrastructure

Location ______________________________

Specific need ______________________________

____

____

Heavy industrial infrastructure

Location ______________________________

Specific need ______________________________

____

____

Highway infrastructure

Location ______________________________

Specific need ______________________________

____

____

AMERICA'S INFRASTRUCTURE
UNIT II

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1 — Evaluated to the satisfaction of the instructor

AMERICA'S INFRASTRUCTURE
UNIT II

TEST

NAME ______________________________ SCORE ____________

1. Define *infrastructure.*

   Infrastructure — ______________________________

2. Name categories of infrastructures.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

3. Select from the following list the purposes of an infrastructure. Write an "X" in the blank before each correct answer.

   _____a. To aid in national defense

   _____b. To strengthen national economy

   _____c. To improve the appearance of the countryside

   _____d. To produce energy

   _____e. To promote public health and safety

   _____f. To improve quality of life and standard of living

   _____g. To provide transportation of goods and services

4. Discuss the present condition of the nation's infrastructure.

   ____

AMERICA'S INFRASTRUCTURE
UNIT II

ANSWERS TO TEST

1. Infrastructure — System of public and private facilities that provides for delivery of essential services to sustain a minimum standard of living

2. a. Building infrastructures
   b. Municipal utilities infrastructures
   c. Heavy industrial infrastructures
   d. Highway infrastructures

3. a, b, d, e, f, g

4. Discussion should include the following

   a. The nation's infrastructure is greatly deteriorated and in need of immediate costly repairs

   b. Repair and maintenance of the infrastructure will stimulate the economy by producing jobs

STARTING A BUSINESS
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to evaluate his or her potential to start a business. The student will show this ability by completing assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with starting a business.
2. List primary factors that contribute to the success or failure of a business.
3. List major sources of information and assistance available to small-business owners.
4. Select from a list specific advisors available from the Small Business Administration.
5. Describe sources of capital used by enterpreneurs.
6. Examine expenses involved in starting a business.
7. Write a plan for small-business ownership.
8. Prepare documentation required for a loan application.
9. Explore problems faced by entrepreneurs in operating a business.
10. Evaluate own potential to start a business.

STARTING A BUSINESS
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplement #1 — Market Factor: When to Take the Risk

   D. Transparency masters

      1. TM #1 — Organizational Plans in Trouble

      2. TM #2 — Organizational Plans in Trouble (Continued)

      3. TM #3 — Organizational Plans in Trouble (Continued)

      4. TM #4 — Sources of Borrowing Short-Term Capital

      5. TM #5 — Standards for Small-Business Loans

   E. Information sheet

   F. Assignment sheets

      1. Assignment Sheet #1 — Examine Expenses Involved in Starting a Business

      2. Assignment Sheet #2 — Write a Plan for Small-Business Ownership

      3. Assignment Sheet #3 — Prepare Documentation Required for a Loan Application

      4. Assignment Sheet #4 — Explore Problems Faced by Entrepreneurs in Operating a Business

      5. Assignment Sheet #5 — Evaluate Own Potential to Start a Business

   G. Answers to assignment sheets

   H. Test

   I. Answers to test

SUGGESTED ACTIVITIES

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Obtain materials to supplement unit.

    1. *FLM — Decisions in Starting a Retail Business*. FLM Publishers, Inc. Available from Fred L. Moore, 3860 Armer, Boulder, Colorado 80303.

    (NOTE: This classroom simulation activity presents ten different types of stores and requires the students to make management-level decisions on twenty marketing and merchandising activities.)

    2. *Small Business Reporter Series*. Bank of America NT&SA, 1976. Available in quantity from Bank of America, Department 3120, P.O. Box 37000, San Francisco, California 94137.

    (NOTE: This series covers fifteen business operations and fifteen business profiles.)

    3. Competency profiles

    (NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006; phone 202-393-2040.)

    4. Additional resources

      a. Everard, Kenneth E., and Bernard A. Shilt. *Business Principles and Management*. Cincinnati: South-Western Publishing Company, 1979.

      b. Hailes, William D. Jr., and Raymond T. Hubbard. *Small Business Management*. Albany, New York: Delmar Publishers, 1977.

      c. Kirkpatrick, Charles A., and Frederick A. Russ. *Business*. Chicago: Science Research Associates, Inc., 1978.

      d. *SCORE/U.S.*, "Fact Sheet for Local Data." Oklahoma City, Oklahoma: Small Business Administration, n.d.

      e. *Small Business Reporter*, "Financing Small Business." San Francisco: Bank of America, 1976.

      f. *Small Business Reporter*, "Steps to Starting a Business." San Francisco: Bank of America, 1976.

SUGGESTED ACTIVITIES

g. U.S. Small Business Administration. *Presentor's Guide Series: Choosing a Form of Organization for Small Business.* Washington, D.C.: U.S. Government Printing Office, 1980.

h. U.S. Small Business Administration. *Presentor's Guide Series: Location and Layout for Small Business.* Washington, D.C.: U.S. Government Printing Office, 1980.

i. U.S. Small Business Administration. *Presentor's Guide Series: Sources of Assistance and Information for Small Business.* Washington, D.C.: U.S. Government Printing Office, 1980.

j. U.S. Small Business Administration. *Steps to Starting a Business in Oklahoma.* Oklahoma City, Oklahoma: Small Business Administration, n.d.

C. Introduce unit.

(NOTE: This unit has two primary purposes. First, it is intended to help students achieve a realistic idea of the complexity of operating their own businesses by emphasizing that successful business ownership requires skills and knowledge that are just as important to the entrepreneur as skills in the use of tools and knowledge of construction procedures are to the craft person. Many of your students probably aspire to own their own businesses, and it is important that they realize that they should try to acquire the necessary skills before rushing into business ownership. Secondly, the unit introduces the students to sources of further information and assistance so that they can take steps to acquire necessary entrepreneurship skills. All of your activities in conjunction with teaching this unit should concentrate on helping your students establish realistic viewpoints and on assisting them in understanding their strengths and weaknesses related to running a business.)

- Ask the class how many of them intend to start their own business. Have each student describe the business operation he or she has in mind. Use this discussion as an opportunity to point out some of the misconceptions that the class may have.

- Use Monopoly or similar games to discuss the money involved in running a business. Ask the students to discuss how many of them would have the amount of cash that one gets to start such a game; discuss how long such an amount of money might last in setting up a business.

- Make a bulletin board or have the students collect articles on the number of small-business bankruptcies, especially bankruptcies involving construction-related businesses.

D. Provide students with unit.

SUGGESTED ACTIVITIES

E. Discuss unit and specific objectives, emphasizing how the objectives relate to your introduction of the unit and your plan of presentation.

F. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss terms associated with starting a small business.

   - Use the terms to make sure that the students know that businesses often operate with borrowed capital and leased facilities and equipment in addition to owned capital.

   - Explain why the word *entrepreneur* is becoming popular, emphasizing that it carries with it the connotation of someone who is dedicated, skilled, resourceful, and industrious enough to make a business a success.

     (NOTE: It is possible that students in your class will be "turned off" by the term *entrepreneur*. If this is the case, do not force it upon them, but do try to use the term in such a way that they accept it as a title of honor or prestige because of the values and characteristics that it presents.)

2. Use Information Sheet, Section II, and Part I of Assignment Sheet #4 to discuss primary factors that contribute to the success or failure of a business.

   - Request information on failure trends in business from the Business Economics Division, Dunn and Bradstreet Corporation, 99 Church Street, New York, New York 10007.

   - Ask a representative of the SBA in your area to discuss the success and failure rates for your area, and the reasons for such.

   - Use Transparencies #1 through #3 to discuss management factors that contribute to the success or failure of a business.

   - Use the FLM materials to acquaint the students with management decisions.

   - Have the students role-play personnel management situations after your discussion of people factors.

   - Invite a panel of entrepreneurs to discuss the factors outlined in Section II. Have the panel discuss how and to what degree their businesses are affected by each factor.

SUGGESTED ACTIVITIES

- Make copies of Supplement #1 and use to discuss market factors and to introduce Section III of the Information Sheet.

3. Use Information Sheet, Section III, to discuss sources of information and assistance available to small-business owners.

    - Invite representatives from various agencies to discuss services that their agencies offer.
    - Relate the services of each agency to the factors discussed in Section II.

4. Continue the discussion of sources of help by discussing specific advisors available through the SBA. Use Information Sheet, Section IV.

    - Invite an SBA representative to talk to the class.
    - Invite a panel of entrepreneurs who have used the SBA services to discuss the results of such assistance.
    - Use Assignment Sheet #4 to reinforce the information in Sections II, III, and IV.

5. Use Information Sheet, Section V, to discuss sources of capital used by entrepreneurs.

    - Invite an accountant or management consultant to discuss the advantages and disadvantages of each type of capital source.
    - Illustrate your discussion of borrowed capital with Transparencies #4 and #5.
    - Use Assignment Sheets #1 through #3 to reinforce the objective and to prepare students to evaluate their potential to start a business.

      (NOTE: If you are unable to find entrepreneurs who can work with the students on these assignment sheets, or if your students are not prepared to work in the cooperative manner required for these assignment sheets, you may wish to use business profiles from the Bank of America series.)

6. Have interested students complete Assignment Sheet #5.

SUGGESTED ACTIVITIES

- Use Supplement #1 to introduce the activity and to relate it to the factors that contribute to the success or failure of a business.

- Have the students discuss with the class the results of their evaluations. Have them examine how their attitudes may have changed from those they held when you first introduced the unit.

G. Give test.

H. Critique test and discuss in class.

I. Reteach and retest if necessary.

J. Counsel each student on his or her potential to start a business, using the test results and Assignment Sheet #5. Emphasize strengths and weaknesses and ways to overcome the weaknesses. Try to get the student to make a realistic assessment of his or her own abilities to start a business, and encourage the student to set up a practical timetable for accomplishing that goal.

K. Complete appropriate section of competency profiles.

III. Unit reference — Hendrix, Laborn J. "Bud". *Fundamentals of Carpentry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1985.

STARTING A BUSINESS
UNIT III

SUPPLEMENT #1 — MARKET FACTOR: WHEN TO TAKE THE RISK

☐ Have you identified the market?

☐ Does there seem to be a market large enough for your business to compete successfully?

☐ Do you know who in your trading area will purchase your goods?

☐ Do you know the income, occupational, and housing patterns of these potential customers?

☐ Do traffic and pedestrian counts give favorable projections for your site?

☐ If your customers will arrive by car, are ample parking areas nearby?

☐ If previous businesses have failed at the site, have you found out why they failed?

☐ Are other stores that handle your type of merchandise prospering in the neighborhood?

☐ Have you come up with a profitable sales estimate?

☐ Does the area have a good safety record?

☐ Is the exterior of your site attractive or can remodeling at reasonable cost improve the exterior image?

☐ Have community business organizations given you a favorable report on the site and business district?

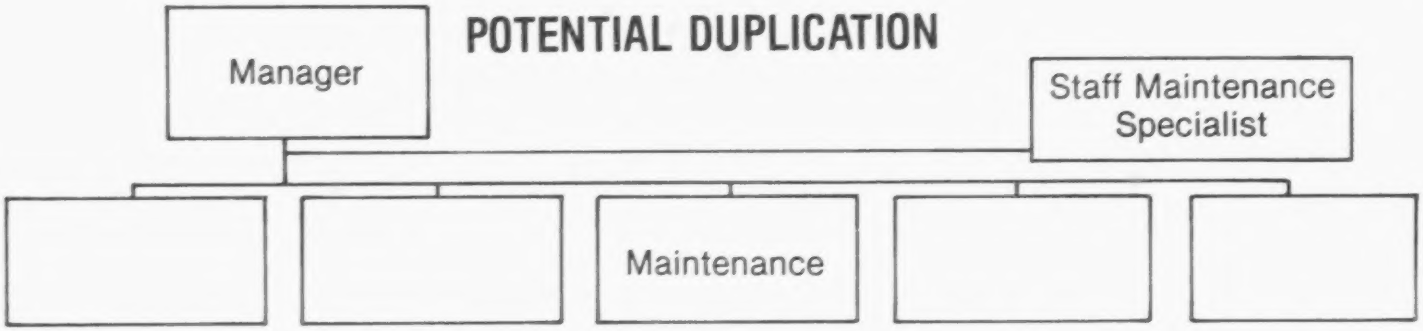
☐ Can you handle the initial investment required to start the business?

☐ Do the terms in your lease offer you protection against possible business failure and rising inflation?

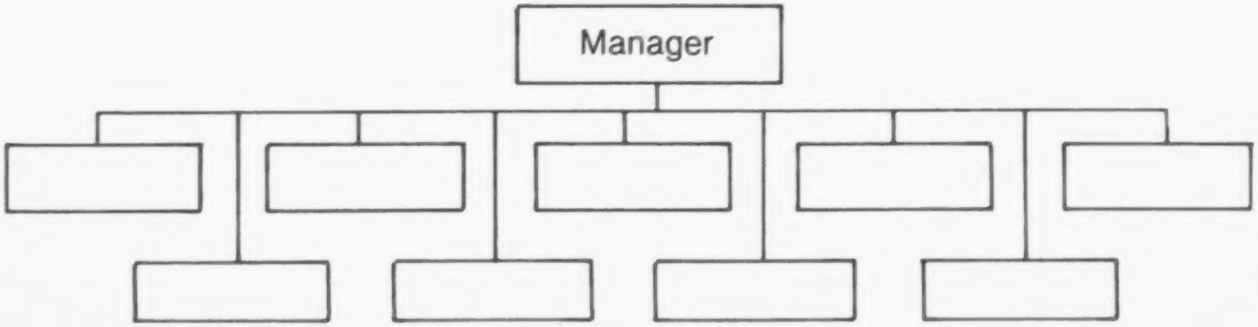
☐ Will you be able to attract employees with the skills needed for your business?

Organizational Plans in Trouble

POTENTIAL DUPLICATION


Manager
Staff Maintenance Specialist
Maintenance

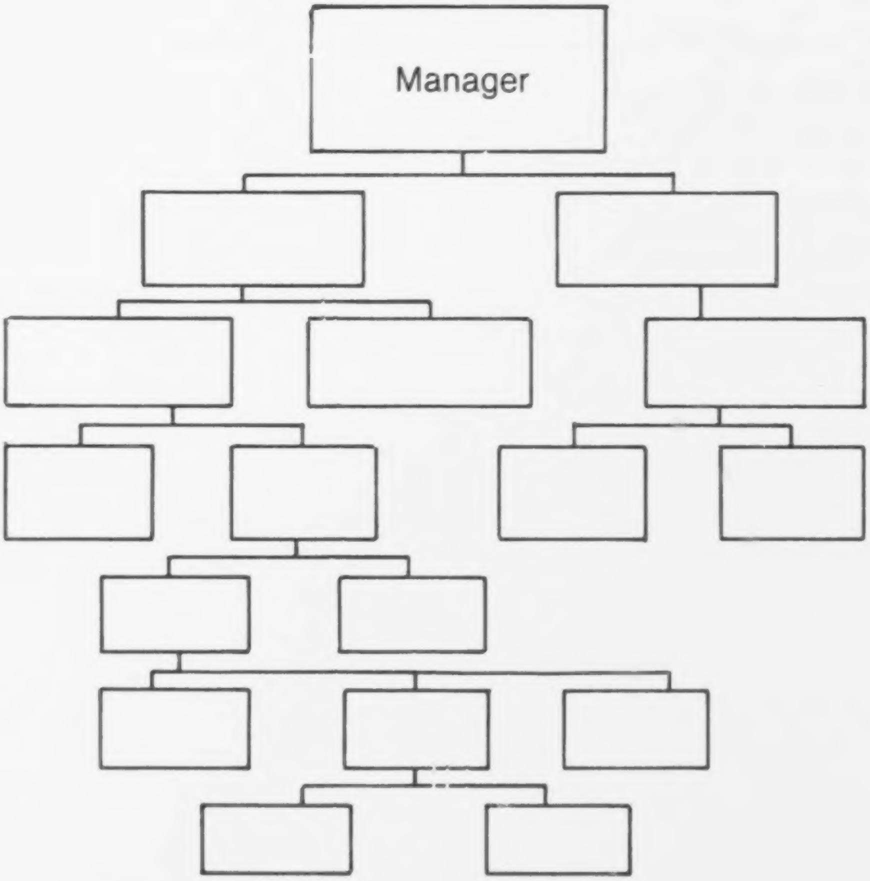
TOO MANY REPORTING TO ONE



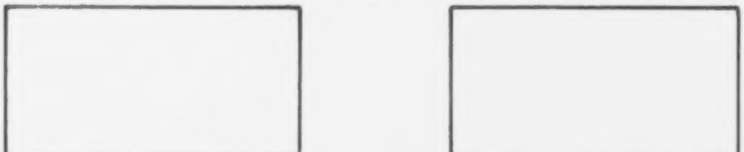
Organizational Plans in Trouble

(Continued)

TOO MANY LEVELS

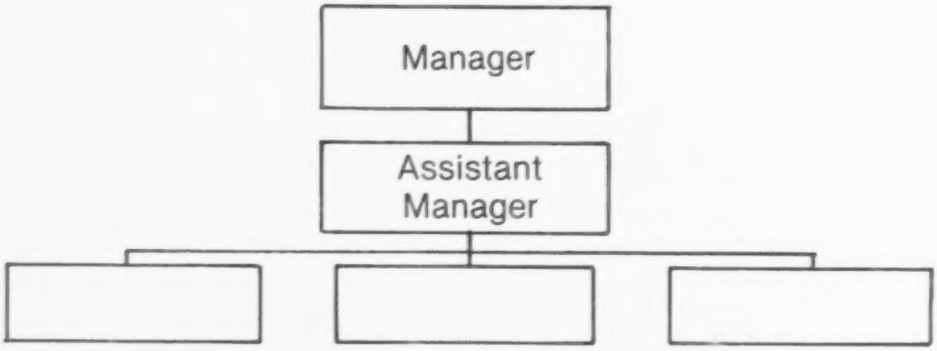


REPORTING TO MORE THAN ONE BOSS



Organizational Plans in Trouble
(Continued)

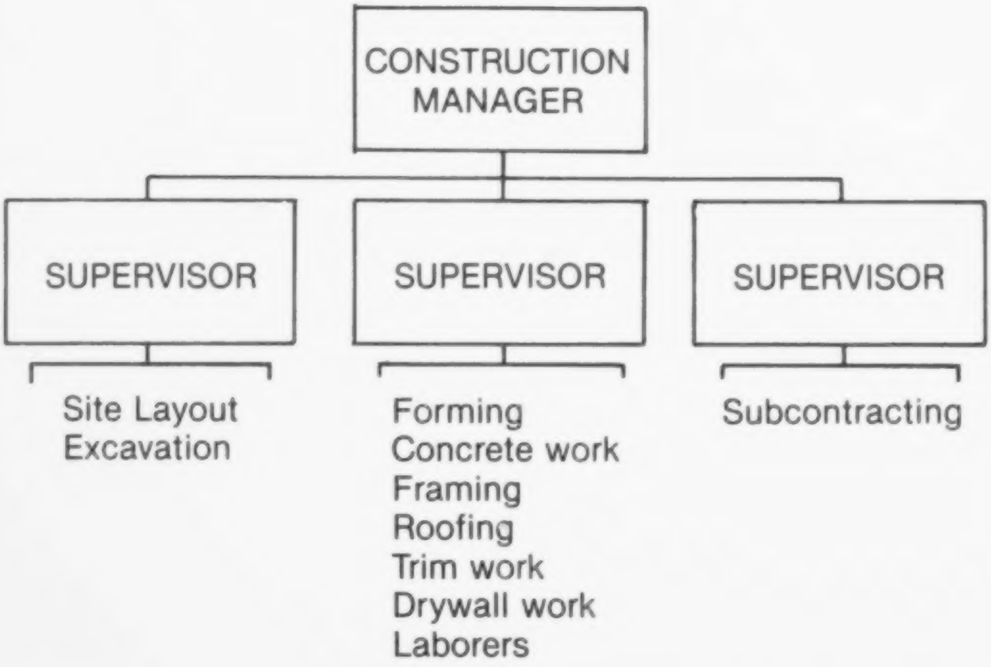
ONE OVER ONE



Manager

Assistant Manager

LOADS OUT OF BALANCE



CONSTRUCTION MANAGER

SUPERVISOR

- Site Layout
- Excavation

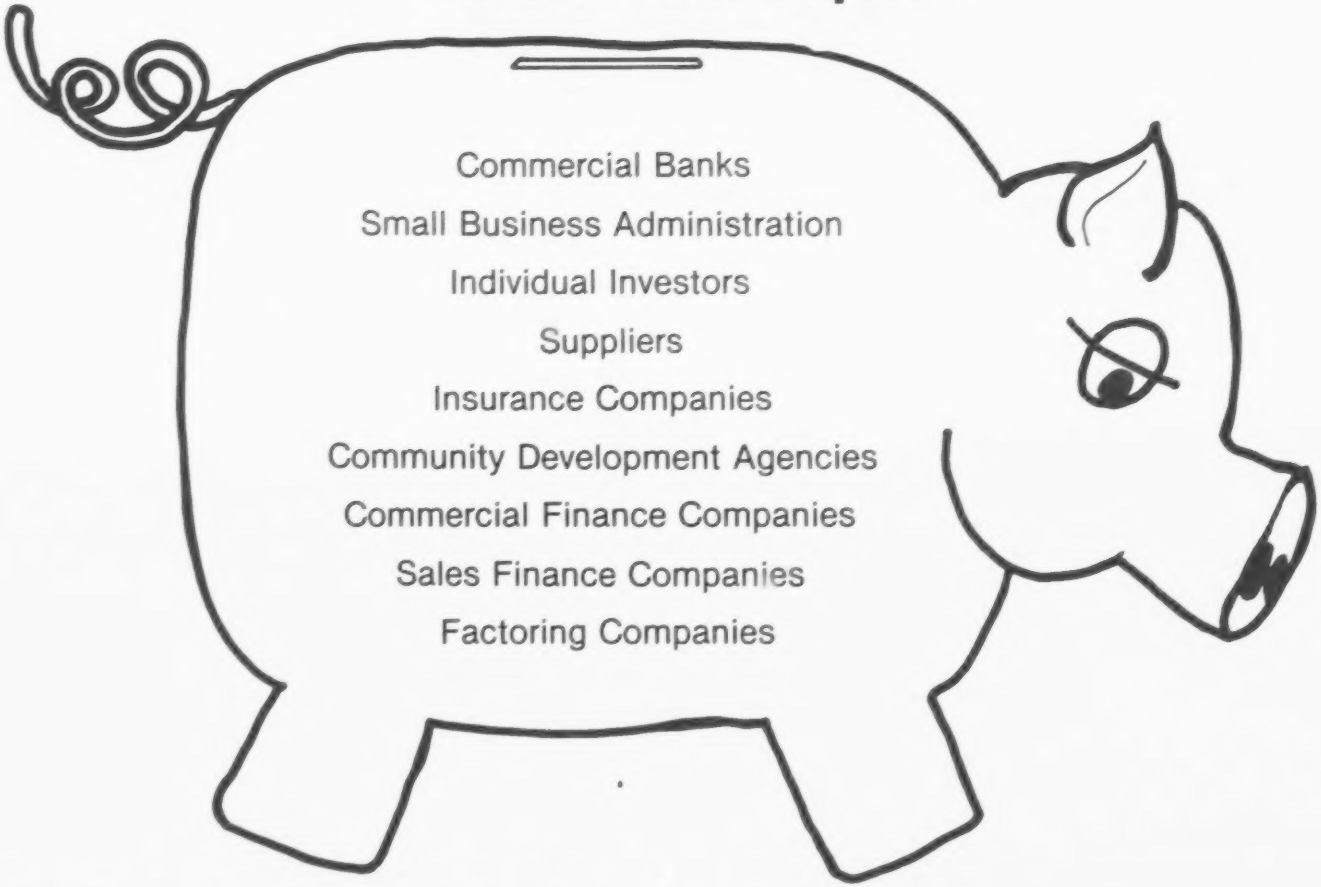
SUPERVISOR

- Forming
- Concrete work
- Framing
- Roofing
- Trim work
- Drywall work
- Laborers

SUPERVISOR

- Subcontracting

Sources of Borrowing Short-Term Capital



Commercial Banks
Small Business Administration
Individual Investors
Suppliers
Insurance Companies
Community Development Agencies
Commercial Finance Companies
Sales Finance Companies
Factoring Companies

TM #4

FOC-97-A

Standards for Small-Business Loans

TYPE OF BUSINESS	ANNUAL SALES	NUMBER OF EMPLOYEES
RETAIL	Not over $2 to $7.5 million, depending on the industry	
SERVICE	Not exceeding $2 million to $8 million, depending on the industry	
WHOLESALING	Not over $9.5 to $22 million, depending on the industry	
MANUFACTURING		Up to 1,500, depending on the industry
GENERAL CONSTRUCTION	Not exceeding $9.5 million for the last three years	
SPECIAL TRADES CONSTRUCTION	Exceeding $1 to $2 million for the last three years, depending on the industry	

STARTING A BUSINESS
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. **Small business** — Business that is independently owned and not dominant in its field of operation

(NOTE: According to the Small Business Administration, 95 percent of all businesses in the United States are small businesses, primarily in the retailing, wholesaling, construction, and service industries.)

B. **Small Business Administration (SBA)** — Federal agency established to assist small-business owners

C. **Entrepreneur** — French word meaning "enterpriser"; a person who owns a business

D. **Capital** — Money, buildings, machines, and investments that are used or available to make products or to provide services

E. **Lease** — Contract to use an item without purchasing it

F. **Collateral** — Personal or business possessions that a borrower assigns to a lender as a pledge of debt payment

EXAMPLES: Tools, machines, building, vehicle(s)

(NOTE: If the borrower does not repay the loan, the lender assumes ownership of the collateral.)

II. Primary factors that contribute to the success or failure of a business

A. Management

(NOTE: Ninety percent of small-business failures result from inexperience or poor management. A number of personal traits affect one's skills as a manager, including the ability to make decisions and give directions, the ability to get along with others, the ability to reorganize and plan, the willingness to take risks, and the ability to bounce back if those risks fail.)

B. People

(NOTE: The success of a business is directly related to the people involved in its operation—not just the management personnel, but the entire staff. People who are skilled, honest, hard-working, and dependable can contribute greatly to the success of a business.)

INFORMATION SHEET

C. Money

(NOTE: The new business owner quickly learns that every aspect of the operation revolves around careful management of the company's finances. Additionally, a company's success or failure depends on economic conditions in its local area and the country. Costs of materials, labor, and facilities and the availability of capital regulate a business' growth and its potential to make a profit.)

D. Market

(NOTE: The success of a business depends on its offering a product that the public wants to buy at the price offered. A carpenter who sets up a cabinet-making shop in a locality where all the construction companies build their own cabinets on the job site is likely to have a difficult time succeeding. Other marketing factors are advertising and selling. Good marketing approaches might convince the construction companies that they can get better-quality cabinets at a lower cost and more effectively from the cabinet shop—leading to the success of the business.)

III. Major sources of information and assistance available to small-business owners

(NOTE: Managers of small businesses frequently have had little experience in business management. Yet, because of the limited amount of resources, the success of a small business is generally more directly dependent on the manager's making good decisions than it is in a large business where costly mistakes may have less effect on the overall success of the company. Additionally, large companies can afford to hire specialists to handle various phases of their operations, while the small-business owner must make all the decisions and do all the planning. For these reasons, a number of agencies and organizations exist to help the small-business owner.)

A. Federal government agencies

EXAMPLES: Small Business Administration, Department of Commerce, Department of Labor, Federal Trade Commission, Government Printing Office, Internal Revenue Service

B. Chambers of commerce

C. Community business development councils

D. Business or trade associations

EXAMPLES: National Retail Merchants Association, National Federation of Independent Business, The Associated General Contractors of America, National Association of Home Builders

E. Credit bureaus

INFORMATION SHEET

F. Better business bureaus

G. Associations of business people

EXAMPLES: Rotary, Kiwanis, Association of Sales and Marketing Executives

H. Special libraries and information centers

I. Business professionals

EXAMPLES: Bankers, management consultants, Service Corps of Retired Executives, accountants, lawyers, insurance agents

J. Personal contacts

EXAMPLES: Other business people, customers, suppliers

IV. Advisors available from the Small Business Administration

A. Management consultants

(NOTE: SBA management consultants offer advice on the kind of business to start, where financing may be available, how to obtain helpful training, and how to find solutions for management problems.)

B. Loan administrators

(NOTE: The SBA makes loans for purchasing equipment and facilities, buying materials, and meeting other expenses related to starting a business.)

C. Contract locators

(NOTE: Contract locators assist small businesses in finding bid information on government contracts and in writing bids to get such contracts.)

V. Sources of capital used by entrepreneurs

(NOTE: *Capital* is the money required to operate a business. Expenses may be *fixed capital* or *working capital* expenses. Fixed capital expenses include money spent to buy tools, buildings, vehicles, and equipment. Working capital expenses consist of salaries, money spent to rent or lease equipment, taxes, insurance costs, and advertising.)

A. Owned capital — Money belonging to the entrepreneur

EXAMPLES: Personal savings, mortgages on personal property

B. Retained earnings — Company profits used to expand the company

INFORMATION SHEET

C. Borrowed capital — Money obtained from lenders such as individual investors, banks, finance companies, and the SBA

(NOTE: Loans may be *short-term* or *long-term*, depending on the amount of time allowed for repayment. Short-term loans are generally repaid over a period of a month to a few years. Long-term loans may be repaid over a period of ten to thirty years or more.)

STARTING A BUSINESS
UNIT III

ASSIGNMENT SHEET #1 — EXAMINE EXPENSES INVOLVED IN STARTING A BUSINESS

NAME ______________________________ SCORE ______________

Many construction workers go into business for themselves. A carpenter may accept a subcontract to do work on a project, may act as the primary contractor, may build structures without a contract and hope to sell the buildings, or may start a company in a related area such as construction equipment or building materials. With all these opportunities, many carpenters are tempted to start their own businesses early in their careers without realizing the kinds of expenses and problems that an entrepreneur may encounter.

This assignment sheet provides you with the opportunity to study two businesses in the field of construction work to become acquainted with the expenses involved in such businesses. Your instructor may ask you to complete one or both of these studies, and will help you obtain the resources necessary to complete this assignment.

PART I — Building a House on Speculation

A. You have decided that you would like to build houses on your own and try to sell them to individuals. This is called *building on speculation*, and such houses are called *speculative* or *spec houses*. You have chosen the floor plan at the end of this assignment sheet because it seems to fit the needs of the buying public in your area. (Remember that the scale shown is the scale originally used when the scale was drawn. The plan has been reduced, so the scale is no longer accurate.)

Your next task is to locate a lot on which you can build the home. Study the house plan and determine the requirements and restrictions for a building site. Then locate a suitable lot in your area. Once you have found a lot, answer the following questions.

1. Where is the lot located?______________________________
2. What is the price of the lot?______________________________
3. Does the house plan fit the restrictions for development on the lot?______________

(NOTE: Various restrictions may be placed on a house before it can be built on a particular site. The house may have a size requirement—minimum, maximum, or both. There may be requirements about the design of the house, such as a two-story, a ranch-style, a minimum number of bedrooms, a wood shingle roof, or a finish material such as stone or brick. A restriction may be placed on the minimum or maximum selling price. The contractor is responsible for being aware of these restrictions and following them; therefore, you may have to complete other parts of this assignment sheet before you can answer this question. For example, you may have to estimate the selling price if such a restriction exists on the lot you have chosen.)

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4. Are there other requirements that will affect the suitability of this lot for your purposes? For example, do you have to start or finish the house within a certain time period? List any such requirements below.

B. When building a spec house, you will have to buy and pay for the materials used in constructing the house. These can cost several thousands of dollars. Although materials suppliers will often sell materials on credit, they frequently expect payment in full within thirty days. Thus, it is often necessary to borrow money to purchase the materials, meaning that the interest charges will add to the expenses of the materials. Study the materials list at the end of this assignment sheet, and then obtain estimates on the costs of the materials. Do not hesitate to shop around for the best prices and payment terms; remember that you have to be concerned with showing a profit.

(NOTE: Be sure to modify the materials list to conform to any local building codes or restrictions on the building site. If you are familiar with estimating procedures, you may want to create your own materials list for the building methods that you would use.)

1. What is the total cost of materials for the house?____________________

2. What kind of credit and financing plans are available from the suppliers you contacted?

3. Often suppliers will offer discounts for large purchases. Were there discounts available from the suppliers you contacted? If so, what kind?

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4. If you have to borrow money to buy the materials, you will be paying interest on the loan until you can pay it back. For that reason, some contractors do not borrow the money they need to purchase specific materials until they are ready to use them. For example, it may take two months from the start of the project until you are ready to hang the drywall. Rather than pay interest on the drywall for two months, you might want to wait to buy the drywall, even if the purchase of all the materials together would entitle you to a discount from the supplier. On the other hand, the costs of building materials fluctuate throughout the year and in another two months the cost may be higher or lower than the price quoted to you now. Thus, it might be a good idea to purchase some material now, if the price is low, even if you will not be ready to use it for a few weeks. Consider the prices you have obtained, interest rates, discounts, and the period that you are likely to have to carry the loan. Discuss what you consider to be the best plan for purchasing materials.

C. Another expense in building a house is the labor. You will not be able to do the entire project by yourself—at least not in a reasonable time. You have two basic choices for getting the work done. You can hire workers as employees of your business, or you can contract with other businesses or individuals to provide the labor at an agreed cost. If you hire people to work for your business, you assume certain responsibilities (providing the employees with sufficient work and providing them with benefits such as insurance, worker's compensation, and a retirement plan), all of which cost you money. Additionally, you may have to provide tools and equipment that would otherwise be provided by the other company if you contracted the work. Both choices have advantages and disadvantages, and many enterpreneurs use a combination of the two, hiring workers for some tasks and contracting out other jobs. There are several things for you to consider before deciding what is right for you. Answering the following questions will help you to make that decision.

1. Contact some contractors to get bids on various phases of the house you are planning. Write the bids in the spaces provided.

   (NOTE: In contracting services, there are many variables that can save you money or cost you time and money. Some things to consider include whether you or the contractor provides the materials. Sometimes a specialty contractor, such as a heating and air-conditioning contractor, can provide you with heating and cooling systems less expensively than you can obtain them from a supplier. You should also consider the warranty the contractor offers on the work and what kind of payment terms are required by the contract.)

   ____________ a. Excavation and foundation contractor

   ____________ b. Framing contractor

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_____________ c. Roofing contractor

_____________ d. Plumbing contractor

_____________ e. Heating and air-conditioning contractor

_____________ f. Electrical contractor

_____________ g. Drywall hangers and tapers

_____________ h. Trim and cabinet contractor

_____________ i. Painters

_____________ j. Flooring and other specialties (carpet, tile, counter tops)

_____________ k. Brick and masonry contractor

_____________ l. Landscaping contractor

_____________ m. Others

2. When estimating the cost of hiring workers to be employees of your company, talk to contractors to get some idea about the costs associated with hiring workers. List the expenses below.

a. Typical hourly wages

_____________ 1) Frame carpenter
_____________ 2) Laborer
_____________ 3) Trim carpenter
_____________ 4) Roofer
_____________ 5) Plumber
_____________ 6) Electrician
_____________ 7) Brickmason
_____________ 8) Concrete mason
_____________ 9) Backhoe operator
_____________ 10) Tile setter

b. Equipment costs (purchase, lease, or hire)

_____________ 1) Scaffolding
_____________ 2) Mortar mixer
_____________ 3) Pneumatic stapler
_____________ 4) Radial arm saw
_____________ 5) Bulldozer

c. Benefit costs for a frame carpenter at the wages above

_____________ 1) Worker's compensation
_____________ 2) Health insurance

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__________ 3) Other insurance (life, liability, etc.)
__________ 4) Retirement
__________ 5) Vacation and sick leave

(NOTE: Determine the approximate cost of a day of sick leave or vacation time by multiplying the hourly wage by eight hours.)

__________ 6) Other benefits

3. Considering the costs of contracting labor and of hiring employees, what do you think is the best method for getting the labor done for your project, and how much will that method cost?

____

____

____

____

D. You should now have some idea of what it would cost and what resources would be necessary for you to build a spec house. You should have decided on the approach you would use in acquiring materials and labor. The next big decision concerns the financing of the project. In a later assignment sheet you will have an opportunity to prepare a financial statement and other documents that will be required to apply for a loan. Right now, you need only consider financing in a general way by studying your answers to the following items.

1. What will be your total cost for the lot and the labor and materials to build the house?

____

2. Approximately how long will it take to complete construction of the house under ideal conditions—that is, good weather, low employee absenteeism, ready availability of contractors, no materials delays?

____

3. What would be a reasonable selling price for the house, considering its size, features, costs to you, location, and your need to make a profit?

____

4. What is the average length of time that a comparable house is on the market in your area?

____

5. How much of the cost of the project would you have to finance with a bank or other institution?

____

ASSIGNMENT SHEET #1

6. What would be the terms of such a loan?

_____________ a. Interest rate?

_____________ b. Monthly payment?

_____________ c. Payback period?

7. The majority of your monthly loan payment will be a finance charge—especially in the early payment period—and each payment will reduce the amount you owe by only a very little amount. If possible, get a payment schedule showing the amount of interest paid each month. Using the schedule, compute how much your profit will be reduced if you are unable to sell the house for

_____________ a. one month.

_____________ b. two months.

_____________ c. three months.

_____________ d. six months.

_____________ e. one year.

_____________ f. eighteen months.

8. List other expenses you may have.

_____________ a. Closing costs

_____________ b. Taxes

_____________ c. Legal fees

_____________ d. Advertising

_____________ e. Others_____________

PART II — Operating a Lumberyard

A. You have decided that you would like to start a retail business to sell building materials. One of your first needs is to find a location for your business, and you may have several choices of facilities. For example, you may be able to rent or lease an existing lumberyard or you may be able to buy an existing lumberyard, with or without merchandise. Another possibility is that you can find some land on which you can build a lumberyard. Frequently, undeveloped land is available for sale or for lease, with the owner willing to build facilities to suit the buyer or lessee. Of course, in choosing any site you will also have to consider whether the location is zoned for the business that you are planning and whether it is a good location in terms of attracting customers and receiving deliveries from suppliers. Check with existing lumberyards and with real estate agents to find a suitable location for your business so that you can answer the following questions.

1. What locations are available to you? Check those available.

☐ Existing lumberyards for sale

☐ Existing lumberyard for rent or lease

☐ Building site for sale

☐ Building site for rent or lease

ASSIGNMENT SHEET #1

2. What would be the approximate cost of buying an existing lumberyard or building your own facilities?

   Total cost ______________________________

   Approximate monthly payments ______________________________

3. What would be the cost of renting or leasing a location complete with necessary facilities, either existing or built to suit your needs?

   Monthly cost to rent or lease ______________________________

4. Will you be able to support yourself while waiting for facilities to be built or readied for business? Explain.

   ____

5. Considering your answers to the preceding questions, what would be your choice of locations for your lumberyard? Why?

   ____

   ____

B. Now that you have some idea of the lumberyards available in your area, and the options for locations and their costs, your next step might be to contact the Small Business Administration for some help and information. The SBA can discuss your plans and advise you as to whether the idea is worth trying and how you should approach the business. Contact your local SBA or a similar organization to discuss starting a building materials business in the locations you have considered. You might want to answer some of the following questions during your discussion.

__________ 1. How many businesses sell lumber in your marketing area?

__________ 2. Would your plans increase that number or leave it unchanged—that is, will you be replacing one of the businesses by renting or buying its facilities?

__________ 3. What is the total dollar value of sales made by all such businesses in your area per year? Per month?

__________ 4. Assuming that all other things were equal, what would be the proportional amount of business that you could expect to attract each month?

__________ 5. What would be the approximate cost of merchandise needed to start the business?

__________ 6. How much would have to be paid toward the merchandise during the first three months of business?

(NOTE: A number of materials suppliers will deliver the materials and bill you later. In this way, you may have thirty days or more before you have to pay for any merchandise.)

ASSIGNMENT SHEET #1

7. What other expenses are likely? How much would they run per month?

__________a. Salaries and benefits

__________b. Utilities

__________c. Advertising

__________d. Office supplies

__________e. Dues (trade associations, chamber of) commerce)

__________f. Taxes

__________g. Insurance

__________h. Equipment

__________i. Professional services (legal, accounting)

__________j. Facilities maintenance

__________k. Other — ______________________________

____

8. In light of monthly expenses, your realistic expectation of income, and your need to make some profit, is it a good idea to start a lumberyard in the location you have chosen or in your area at all? Why?

____

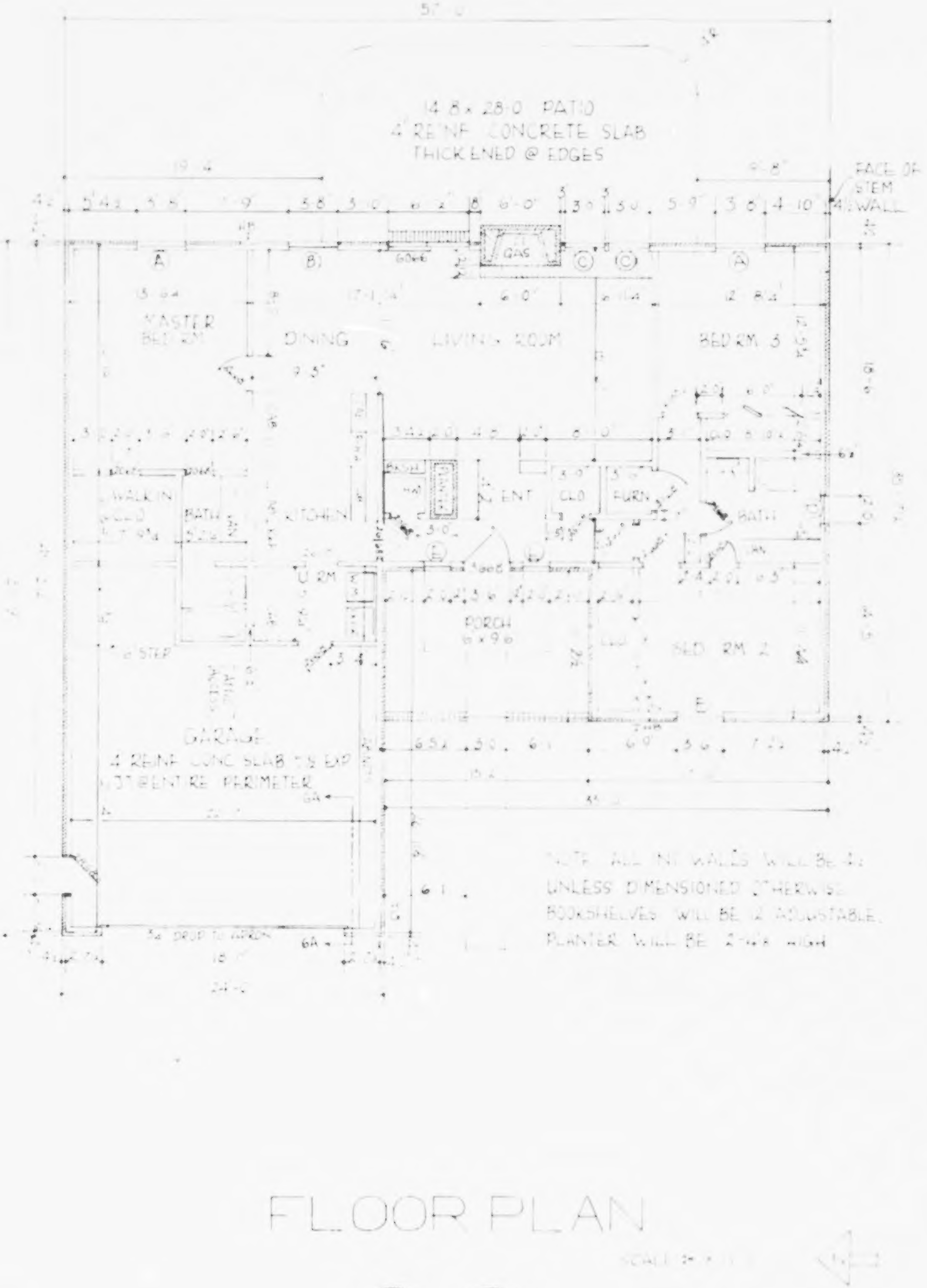
____

9. Are other construction-related businesses good choices? If so, what and why?

____

____

ASSIGNMENT SHEET #1


52'-0"
14'-8" x 28'-0" PATIO
4" REINF. CONCRETE SLAB
THICKENED @ EDGES
19'-4"
FACE OF STEM WALL
GAS
MASTER BED RM
DINING
LIVING ROOM
BED RM 3
WALK IN CLO
BATH
KITCHEN
ENT
CLO
FURN
BATH
U RM
PORCH
6' x 9'-6"
CLO
BED RM 2
GARAGE
4" REINF. CONC. SLAB 1/2" EXP. JT. @ ENTIRE PERIMETER
1/2" DROP TO APRON
18'-0"
24'-0"
FLOOR PLAN
SCALE

NOTE: ALL INT. WALLS WILL BE 4½" UNLESS DIMENSIONED OTHERWISE.
BOOKSHELVES WILL BE 12" ADJUSTABLE.
PLANTER WILL BE 2'-4" HIGH.

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ASSIGNMENT SHEET #1

MATERIALS LIST

Item	Quantity	Cost	Total
Concrete (poured slab)			
CD plywood, ½"	10 shts		
2×4 utility	160 bd ft		
#5 rebar	1400 ft		
Pins, 24"	220		
Wire mesh, 6 × 6–W1.4 × W1.4	4 rolls		
Concrete	50 cu yds		
Anchor bolts, ½" × 8"	30		
Dimensional lumber			
Precut studs	400		
2×4	800 bd ft		
2×6	78 bd ft		
2×10	20 bd ft		
2×12	36 bd ft		
#12 white pine 1×12	240 bd ft		
#2 white pine 1×12	50 bd ft		
AB plywood, ¾"	4 shts		
LC ash, ½"	4 shts		
FC ash, ½"	6 shts		
AD plywood			
4' × 8' × ½"	6 shts		
4' × 8' × ¼"	13 shts		
Roofing			
Trusses			
23'	13		
23' gable end	1		
18'	6		
18' gable end	1		
23'–10"	28		
23'–10" gable end	2		
2×8	270 bd ft		
CD plywood			
4' × 8' × ½"	93 shts		
Plywood clips	1 box		
Felt paper, 30#	8 rolls		
Asphalt shingles	30 sqs		
Flashing, 12"	100 ft		
Exterior			
Cedar plywood			
4' × 8" × ½"	12 shts		
#2 rough cedar 1×12	80 bd ft		
Bricks	6000		
Screen mold	500 Ln ft		
Brick mold	150 Ln ft		
Drywall			
4' × 8' × ½"	170 shts		
Tape	4 rolls		
Filler	5 gal		
Windows (double-glass aluminum)			
Double-hung			
3'–8" × 3'–0" 4-light	2		
3'–8" × 5'–0" 4-light	1		
2'–0" × 3'–0" 4-light	1		
3'–6" × 5'–0" 16-light	1		
Fixed			
3'–0" × 5'–0" single-light	2		
2'–0" × 6'–0" 20-light	2		
Trim			
Doors (ash unless indicated otherwise)			
2068 1⅜" HC	5		
2468 1⅜" HC	1		
2668 1⅜" HC	6		
3068 1¾" SC	1		
3668 1¾" SC	1		
2668 Cafe	1 pr		
2668 Pocket	1		
2668 1¾" Metal fireproof	1		
6068 Bifold, 1¼"	2 sets		
6068 Sliding patio, aluminum	1		
1956 Shower, frosted glass	2 sets		
Thresholds, 1" Alum	3		
Hinge sets 3½" × 3½"	12		
Hinge sets 4" × 4"	3		
Interior jamb sets and stop	17		
Exterior jambs	4		
Base	500 Ln ft		
Locksets			
Entry	3		
Privacy	6		
Closet	5		
Drawer guides	22		
Drawer pulls	22		
Cabinet pulls	24		
Cabinet hinge sets	24 pr		
Attic ladder pulldown	1		
Garage door, 7' × 18'	1		

ASSIGNMENT SHEET #1

Item	Quantity	Cost	Total	Contract bid
Trim (cont'd)				
Spindles, 3" × 30"	3	____	____	
Laminate				
Butcher block	50 sq ft	____	____	
Marble	30 sq ft	____	____	
Stove top	1	____	____	
Oven	1	____	____	
Garage door opener	1	____	____	
Other (contracted)				
Guttering				____________
Plumbing (including all fixtures and disposal)				____________
Heating and air conditioning (including units, vents, etc.)				____________
Electrical (including outlets, plates, fixtures, etc.)				____________
Painting and staining				____________
Carpeting and flooring (including materials and installation)				____________
Masonry work				____________

(NOTE: Other materials may be provided by the builder or the subcontractors. For example, the drywall work might be contracted. The drywall subcontractor would probably furnish the tape, plaster, nails, and corners. A roofer might furnish the staples if using a pneumatic stapler. This listing is intended to give you some idea of the cost of materials and is not intended to be an exact itemization of the materials needed to construct the plan shown. The true amount of materials will vary with construction techniques, grades of materials, owner's desires, and other factors.)

STARTING A BUSINESS
UNIT III

ASSIGNMENT SHEET #2 — WRITE A PLAN FOR SMALL-BUSINESS OWNERSHIP

NAME ______________________________ SCORE ______________

Few people are able to start a business without receiving financial assistance. Such assistance may come from established lending institutions such as banks and savings and loan associations, from friends or relatives, or from other individuals who invest in the company. One of the most important steps in securing financial assistance is the business plan. Basically, the business plan explains what the business does, how it operates, and why the business deserves the loan or deserves to be considered as a business investment. The entrepreneur uses the business plan to interest potential lenders or investors in providing financial assistance.

In this assignment sheet, you will work with business people to write a plan for small business ownership. Your plan will be based on your work on Assignment Sheet #1 or on the business person's actual business. If possible, you will consider real needs of that person's business, such as expansion of facilities, purchasing a large piece of equipment, or improving service capabilities. The figures and information that you will be using are realistic enough to make this exercise valuable to you, but they may not reflect the exact operation and financial status of the business. In any event, you should be considerate of the business person with whom you work, and treat the information with all seriousness and confidentiality.

Below is an outline of the kind of information that might be contained in a business plan.

Sample Business Plan Outline

- I. Cover letter
  - A. Dollar amount requested
  - B. Terms and timing
  - C. Type and price of securities
- II. Summary
  - A. Business description
    - 1. Name
    - 2. Location and plant description
    - 3. Product
    - 4. Market and competition
    - 5. Management expertise
  - B. Business goals
  - C. Summary of financial needs and application of funds
  - D. Earnings projections and potential return to investors
- III. Market analysis
  - A. Description of total market
  - B. Industry trends
  - C. Target market
  - D. Competition
- IV. Products or services
  - A. Description of product line
  - B. Proprietary position: patents, copyrights, and legal and technical considerations
  - C. Comparison to competitors' products
- V. Manufacturing process (if applicable)
  - A. Materials
  - B. Sources of supply
  - C. Production methods
- VI. Marketing strategy
  - A. Overall strategy
  - B. Pricing policy
  - C. Sales terms
  - D. Method of selling, distributing, and servicing products
- VII. Management plan
  - A. Form of business organization
  - B. Board of directors composition
  - C. Officers: organization chart and responsibilities
  - D. Résumés of key personnel
  - E. Staffing plan/number of employees
  - F. Facilities plan/planned capital improvements
  - G. Operating plan/schedule of upcoming work for next one to two years
- VIII. Financial data
  - A. Financial history (five years to present)
  - B. Five-year financial projections (first year by quarters; remaining years annually)
    - 1. Profit and loss statements
    - 2. Balance sheets
    - 3. Cash-flow chart
    - 4. Capital-expenditure estimates
  - C. Explanation for projections
  - D. Key business ratios
  - E. Explanation of use and effect of new funds
  - F. Potential return to investors; comparison to average return in the industry as a whole

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ASSIGNMENT SHEET #2

A. Cover letter

1. Discuss the amount of money that will be necessary for the required project.
2. Discuss the terms and timing of a loan for that amount.
3. Ask the business person to explain securities to you and what kind of securities will be required for the loan.

B. Summary

1. Work with the business person to put together a description of the business.
    a. Name of business — ______________________________
    b. Location — ______________________________
    c. Product or service — ______________________________
    d. Potential for profit in light of the market and the competition — __________ ______________________________
    e. Management experience and expertise — ______________________________ ______________________________
2. Ask the business person to explain the business' goals to you.
3. Discuss why money should be borrowed for this project and why this approach is the best way to acquire the funds.
4. Discuss how this project can help increase the business' earnings and why that will be beneficial to investors.

C. Market analysis

1. Discuss how the business fits into the total market for this product or service in your area.
2. Discuss whether the need for the product or service is growing or declining in your area.
3. Have the business person describe the business' typical customers.
4. Weigh the business' strengths and weaknesses in comparison to other businesses offering the same product or service.

ASSIGNMENT SHEET #2

D. Products or services

1. Discuss specific products and services offered by the business.

2. Discuss any proprietary positions that the business might have, such as exclusive distributorships or exclusive services.

3. Weigh the strengths and weaknesses of the business' products and services in comparison to those of competitors.

E. Marketing strategy

1. Discuss the types of advertising and marketing approaches used by the business.

2. Discuss how the business arrives at prices and how much profit it expects to make, overall and on individual products and services.

3. Examine the terms of sales, including means of checking credit, whether financing is made by the business or a third party, whether revolving accounts and layaway plans are available, what warranties are offered, and collection procedures.

4. Discuss the business' methods of selling and distributing products and services—that is, are all sales made in a store or do they have field representatives; do they deliver products; if offering a service, do they restrict the distance they are willing to travel to perform the service; are the costs of some services passed on to the customer?

F. Management plan

1. Ask how the business is organized; for example, is it owned by one person, a partnership, a corporation?

2. If the business has a board of directors, ask the business person to explain the roles and backgrounds of board members.

3. Discuss the structure of the organization and the responsibilities of the people within this structure.

4. Discuss the background and qualifications of key personnel.

   (NOTE: As you discuss the staffing of the organization, compare your training, background, and management qualities to those being discussed so that you may form a realistic idea of how you compare to people who are actually serving in roles that you may want to try someday, such as being the owner of a small business or the manager of a larger one.)

5. Discuss the number of employees and their jobs; pay particular attention to how the number of employees or their duties may have changed in the past few years.

ASSIGNMENT SHEET #2

6. Discuss the business' facilities and how these facilities may have changed or may need to be changed.

7. Ask the business person to describe to you any future plans or goals that the business may have for growth or expansion of services.

G. Financial data

(NOTE: Remember that you will be working with realistic figures even if they are not the actual financial data of the business. Even approximate figures should be treated with respect and confidence.)

1. Discuss the business' financial growth or decline over the past five years.
2. Discuss the potential for financial growth or decline over the next five years, including
    a. Probable profit and loss;
    b. Planned equipment and inventory balances;
    c. Methods used to ensure that income is generated and capital is properly spent;

       (NOTE: The transfer of money between and among businesses and individuals is called *cash flow*)
    d. Planned spending for expansion, new equipment and facilities, etc.
3. Discuss the system that the business person uses to estimate future income and expenses.
4. Have the business person explain any formulas or ratios used in financial planning, such as a percentage of profit for expansion or employee profit-sharing, a percentage of gross income for advertising and marketing, etc.
5. If the business person is planning to borrow money, ask how the money will benefit the business; otherwise, ask ways in which the business could benefit if it were to borrow money for some purpose.
6. Ask how the improvements to the business from the borrowed money will improve the business' ability to compete in the market and how customers and investors will benefit.

STARTING A BUSINESS
UNIT III

ASSIGNMENT SHEET #3 — PREPARE DOCUMENTATION REQUIRED FOR A LOAN APPLICATION

NAME ______________________________ SCORE ______________

Most entrepreneurs are unable to start their businesses without receiving some financial assistance. Often the loan comes from friends or relatives, but in most cases the necessary money comes from a bank or other commercial lending institution. These lending institutions are businesses too and must be careful with their resources in order to stay in operation. For that reason, lenders require borrowers to provide detailed information about how the money is to be used and proof that the borrower can repay the loan. Although the exact requirements will vary from institution to institution, and with the purpose and amount of the loan, the example below shows a typical outline of the types of documents that might be required.

Sample Loan Package Outline

I. Summary

  A. Nature of business
  B. Amount and purpose of loan
  C. Repayment terms
  D. Equity share of borrower (debt/equity ratio after loan)
  E. Security or collateral (listed with market value estimates and quotes on cost of equipment to be purchased with the loan proceeds)

II. Personal information (on all corporate officers, directors, and any individuals owning 20 percent or more of the business)

  A. Education, work history, and business experience
  B. Credit references
  C. Income tax statements (last three years)
  D. Financial statement (not over sixty days old)

III. Business information (whichever is applicable below—A, B, or C)

  A. New business

    1. Business plan
    2. Life and casualty insurance coverage
    3. Lease agreement
    4. Partnership, corporation, or franchise papers, if applicable

  B. Business acquisition (buyout)

    1. Information on acquisition

      a. Business history (include seller's name, reasons for sale)
      b. Current balance sheet (not over sixty days old)
      c. Current profit and loss statements (preferably less than sixty days old)
      d. Business' federal income tax returns (past three to five years)
      e. Cash-flow statements for last year
      f. Copy of sales agreement with breakdown of inventory, fixtures, equipment, licenses, goodwill, and other costs
      g. Description and dates of permits already acquired
      h. Lease agreement

    2. Business plan
    3. Life and casualty insurance

  C. Existing business expansion

    1. Information on existing business

      a. Business history
      b. Current balance sheet (not more than sixty days old)
      c. Current profit and loss statements (not more than sixty days old)
      d. Cash-flow statements for last year
      e. Federal income tax returns for past three to five years
      f. Lease agreement and permit data

    2. Business plan
    3. Life and casualty insurance
    4. Partnership, corporation, or franchise papers, if applicable

IV. Projections

  A. Profit and loss projection (monthly, for one year) and explanation of projections
  B. Cash-flow projection (monthly, for one year) and explanation of projections
  C. Projected balance sheet (one year after loan) and explanation of projections

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ASSIGNMENT SHEET #3

In this assignment sheet you will prepare the documents necessary to apply for a loan to start a business. Use the information you gathered in Assignment Sheet #1 when preparing the documents. Be realistic with your information, even if you have to guess at much of it. Your instructor will evaluate your work, using standards used by commercial lenders, or will invite staff members from the SBA or lending institutions to evaluate your work as if it were a real loan application.

Complete each section of the assignment sheet that applies to your situation. Samples of each document can be found at the end of this assignment sheet.

A. Summary

1. Nature of business
    - a. Business name ______________________
    - b. Location of head office ______________________
    - c. Services and products offered ______________________ ______________________
2. Amount requested ______________________
3. Purpose of loan ______________________
4. Repayment terms
    - a. Size of monthly payment desired ______________________
    - b. Time required to repay loan ______________________
4. How much of your own money has been put into the business or will be put into the business compared to the total value of the business?

    ____

    (NOTE: The investment of your own money determines how much of the business you own outright and is called your *equity* in the business.)

5. What security or collateral are you offering for the loan?

    ____

    (NOTE: The borrower of a large loan is required to offer security that the loan will be repaid. Generally, the security is in the form of agreeing to give the lender something of value if the borrower is unable to repay the loan. For example, if you borrow money from a bank to buy a truck but fail to make the required payments, the bank may take possession of the truck.)

ASSIGNMENT SHEET #3

B. Personal information

1. List any schools attended (including trade schools) and degrees received.

School	Location	Dates From	 To	Degrees

2. List your employment for the past five years, beginning with your present or most recent job.

Employer	Address	Supervisor	Your Title	Dates From	 To

3. Attach income tax statements for the past three years and a financial statement no older than sixty days.

(NOTE: The income tax statements and financial statements are typical of documents requested by lenders. Do not attach your own income tax statements or financial statements to this assignment sheet. You will not be required to show these documents to your instructor. However, if you choose to share the information with a loan officer from a lending institution or if you seriously wish to assess your eligibility for a loan, you may wish to have such documents available when you meet with the loan officer.)

C. Business information

(NOTE: Entrepreneurs generally apply for one of three kinds of business loans. They may borrow money to start a new business or to expand a business that they are already managing or they may borrow money to purchase an existing business. Each of these purposes requires slightly different documentation. For this assignment sheet, you will probably be applying for money to start a new business or to buy an existing one. If you are starting a new business, complete the information in item 1. If you are trying to buy an existing business, skip item 1 and go to item 2.)

ASSIGNMENT SHEET #3

1. New business

   a. Describe your business plan. You should discuss your facilities and location, hours, staffing, sales techniques, methods of purchasing, and other information that will show that you are knowledgeable of business practices and that you are working to make a profit.

   b. List any life or casualty insurance coverage you have that will be connected with the business.

   c. What are the terms of any lease agreements connected with the business (facilities, equipment, etc.)?

2. Existing business acquisition

   a. Give a brief history of the business, including the owner's name and the reason for the sale.

ASSIGNMENT SHEET #3

b. Attach current balance sheets and profit and loss statements (less than sixty days old). Also attach the business' federal income tax statements for the past five years and the previous year's cash-flow statement.

(NOTE: You need not attach these to this assignment sheet unless you are actually meeting with a loan officer and have real documents to consider.)

c. Attach a copy of the sales agreement that transfers the business to you, including a breakdown of inventory, facilities, and equipment; outstanding debts; transferrable licenses and permits; and other expenses or assets. Include also a listing of any permits already acquired, with descriptions and effective dates.

d. Describe the existing business plan and tell how you intend to change it (if at all). You should include information about the facilities and location, hours, staffing, sales techniques, methods of purchasing, and other facts that will show that you are knowledgeable about business practices and that you are working to make a profit.

e. List any life or casualty insurance coverage you have that will be connected with the business.

ASSIGNMENT SHEET #3

D. Projections

1. Explain how much money you expect to make or lose each month for the first year of operation and give reasons for your expectations.

Month one — ______________________________

____

Month two — ______________________________

____

Month three — ______________________________

____

Month four — ______________________________

____

Month five — ______________________________

____

Month six — ______________________________

____

Month seven — ______________________________

____

Month eight — ______________________________

____

Month nine — ______________________________

____

Month ten — ______________________________

____

Month eleven — ______________________________

____

ASSIGNMENT SHEET #3

Month twelve — ____

____

(NOTE: Many lenders would also ask you to project your cash flow each month during the first year. You may wish to discuss cash flow with the lending officer with whom you are working.)

2. Explain what you think you can expect to have in the way of assets and debts one year after the loan. Give reasons for your expectations.

   (NOTE: Assets are those things that the company has paid for and owns completely, such as facilities, inventory, and equipment.)

ASSIGNMENT SHEET #3

SAMPLE LOAN PACKAGE
SUMMARY

Cedar Ridge Development Company, Inc.
114 W. Haskell Ave.
Cedar Ridge, Oklahoma 74989

Nature of business:	Cedar Ridge Development Company, Inc. (CRDC) has been formed to develop a 38-acre tract of land southwest of the town of Cedar Ridge. The plat consists of fifteen building sites ranging in size from 2.4 to 3.1 acres. Approximately 4.8 acres are reserved for streets and easements. CRDC plans to grade and pave roads, partially clear lots, and landscape the entrance to the development and other areas retained by the company.
Amount and purpose of loan:	CRDC would like to obtain $108,000 to make improvements to the property. Approximately $40,000 would be required in each of the first two months, with $20,000 and $8,000 respectively for the third and fourth months.
Repayment terms:	CRDC offers to repay the loan at a rate of approximately $3,000 per month for a period of not more than eighteen months, with a balloon payment of the balance. Cash flow should allow payments to begin four months from the date of the loan.
Equity share of borrower:	CRDC is incorporated under the laws of the State of Oklahoma. Currently, all shares are owned jointly by Ralph and Wanda Cummings. The sale of each lot will include ten shares of common stock, amounting to 3 percent of the stock available, or a total of 45 percent of the stock. Fifty-five percent of the stock will be retained by Ralph and Wanda Cummings upon selling all lots under development. Monies paid for shares will be placed in an interest-bearing account and used for maintenance of CRDC-owned streets and grounds within the development. A copy of the articles of incorporation is included as attachment 1 of this loan package.
Collateral:	Deed to the property being developed is to be placed as collateral for the loan. Appraised value of the undeveloped property as of 15 February 1987, is $76,000.

FOC-129-A

ASSIGNMENT SHEET #3

SAMPLE LOAN PACKAGE
PERSONAL INFORMATION

Name: Ralph Cummings

Address: 114 W. Haskell Avenue
Cedar Ridge, Oklahoma 74989

Phone: (405) 555-3879

Personal: Born—February 6, 1962
Married, 2 children

Education: Small Business Management Short Course, July 1985
Tulsa Junior College
Tulsa, Oklahoma

The Associated General Contractors of America Apprenticeship Program, September 1982
Tulsa, Oklahoma

River City High School, May 1980
River City, Oklahoma

Carpentry Certificate, May 1980
Riverview Area Vocational and Technical School
River City, Oklahoma

Employment: Framing and trim carpenter
Verdigris Construction Company, June 1985 to present
831 S. Pine Avenue
Bonner, Oklahoma 73989
Jim Ferguson, supervisor

Framing carpenter and roofer
Shaw and Sons Construction Company, October 1982 to June 1985
3319 W. Castle Boulevard
Tulsa, Oklahoma 73988
William Hudson, supervisor

Carpenter's apprentice, laborer
R and R Incorporated, July 1980 to October 1982
4618 Belle Vista Street
Tulsa, Oklahoma 73986
Richard Elmo, supervisor

ASSIGNMENT SHEET #3

SAMPLE LOAN PACKAGE
PERSONAL INFORMATION

Name:	Wanda Kates Cummings
Address:	114 W. Haskell Avenue Cedar Ridge, Oklahoma 74989
Phone:	(405) 555-3879
Personal:	Born—March 31, 1962 Married, 2 children
Education:	Real Estate Short Course, March 1986 Sooner State Area Vocational and Technical School Cedar Ridge, Oklahoma
	B.A., Elementary Education, May 1984 Oklahoma State University Stillwater, Oklahoma
	River City High School, May 1980 River City, Oklahoma
Employment:	Teacher Cedar Ridge Elementary School, August 1986 to present Cedar Ridge, Oklahoma
	Sales agent Cedar Ridge Realty Company (part-time), August 1986 to present Cedar Ridge, Oklahoma Ann McMurtry, Owner
	Teacher Garriot Elementary School, August 1984 to May 1986 Tulsa, Oklahoma Sarah Myers, Principal
Credit references for Ralph and Wanda Cummings:	River City State Bank 102 Main Street River City, Oklahoma 73993
	Oklahoma Teachers' Credit Union 3618 N. Dillingham Avenue Oklahoma City, Oklahoma 73995
	Cedar Ridge Builders' Supply 319 E. Sandusky Street Cedar Ridge, Oklahoma 74989
	First National Bank of Cedar Ridge 203 N. Main Street Cedar Ridge, Oklahoma 74989

ASSIGNMENT SHEET #3

SAMPLE LOAN PACKAGE
FINANCIAL STATEMENT

Personal financial statement of Ralph and Wanda Cummings, including assets of Cedar Ridge Development Company, Inc., as of March 1, 1987.

ASSETS		
Cash on hand and in checking accounts		$ 1231.18
Savings accounts		946.70
Life insurance cash value		1426.00
Real estate:	Home	71,500.00
	Land	76,000.00
Vehicles:	Car	8950.00
	Pickup	8375.00
Tools		4200.00
Personal property		10,000.00
	TOTAL ASSETS	$182,628.88

LIABILITIES		
Mortgage balance on house		$ 49,734.00
Notes payable to banks, credit unions, etc.:	Car	6621.25
	Pickup	2744.00
Revolving accounts		6014.00
Unpaid taxes (inheritance taxes)		3681.15
Accounts payable (Cedar Ridge Builders' Supply)		497.36
	TOTAL LIABILITIES	$ 69,291.76
	NET WORTH	$113,337.12

ASSIGNMENT SHEET #3

SAMPLE LOAN PACKAGE
BUSINESS PLAN

CEDAR RIDGE DEVELOPMENT COMPANY, INC.
114 W. Haskell Avenue
Cedar Ridge, Oklahoma 74989

History of business:

Cedar Ridge Development Company, Inc. was formed and incorporated under the laws of the State of Oklahoma on January 25, 1987, with offices at 114 W. Haskell Avenue, Cedar Ridge, Oklahoma. The company's primary asset is a tract of land transferred to the company by the major shareholders, Ralph and Wanda Cummings and obtained by them through inheritance.

Plan of operation:

Upon securing adequate financing, CRDC will develop the tract into fifteen home sites according to the attached plat plan. The lots will be sold through the company's real estate division, headed by licensed agent Wanda Cummings. Selling prices will range from $12,500 to $15,000. Lots will be sold to individuals and to construction companies interested in building houses in the $85,000 to $110,000 price range meeting the restrictions outlined by the company. A minimum of five of the houses will be built under contract with individuals by the CRDC construction division under the supervision of Ralph Cummings. Additionally, profits from contracted construction may be applied toward the construction of two to three houses built on speculation.

Total cost for developing the land will be approximately $200,000, excluding the costs of building houses. Development should be complete within three years.

Owners of the homes will become stockholders in CRDC, which shall create a trust fund to cover the costs of maintaining the development. Terms of the agreement and trust are contained in the bylaws of the corporation.

Sales plan:

The development will be advertised locally in newspapers, on radio, and by billboard. Special events will include a grand opening and open houses.

The company belongs to the Cedar Ridge Chamber of Commerce and adheres to its objectives and procedures. Ralph and Wanda Cummings are active in the community. They are well known and trusted.

The real estate division is affiliated with the Cedar County Real Estate Council and subscribes to its multilisting service.

The construction division is affiliated with the Green Country Home Builders Association. Other GCHBA members have pledged support with building materials and construction crews and are enthusiastic about the project.

ASSIGNMENT SHEET #3

Managerial capacity:

Both Ralph and Wanda Cummings have demonstrated sound business skills and practices. Mrs. Cummings graduated at the top of her class in real estate school and has twice been monthly sales leader for brokers with whom she has worked, despite the fact that much of her work in the real estate field has been part-time while she has served as a school teacher.

Ralph was recently promoted to crew supervisor at the company where he presently works. Additionally he has done independent contracting work for the past five years, doing remodeling work with a crew of two. All of his employers and those contracting his services have been well-pleased with his work. Letters of reference are attached.

The Cummings have demonstrated their seriousness in this project through careful research into the need and marketing strategies for the development. They have followed the laws and regulations regarding corporations in this state and have worked closely with local chambers of commerce, the Small Business Administration, and professional organizations to ensure that a market exists and that the community has access to the resources necessary to make the project a success.

Market potential:

Studies by the Cedar Ridge Chamber of Commerce and the Green Country Development Board show a pressing need for such a development. The Chamber estimates that between forty and fifty homes in this price range will be needed over the next three to five years. The new ball-bearing plant and continued petroleum activity will continue to draw people to this area. The Chamber's report emphasizes that the town of Cedar Ridge will not be able to provide adequate water and sewage treatment without the aid of private developers.

The Cedar County Real Estate Council reports a critical shortage of rural acreages, "especially for homes about $100,000 on wooded sites of less than five acres." Time on the market for such houses is averaging less than two months and is not expected to exceed four months during the next two years. The return of lower interest rates has further stimulated this market.

Development of Cedar Ridge Estates will stimulate the community's economy. Approximately $1.5 million will be spent on building materials for the project. At least half of the houses will be financed locally if current trends hold true. Development of the project will create fifteen to twenty jobs in construction alone. The development will create a sizeable boost in property tax revenues, resulting in better facilities and services for the community.

ASSIGNMENT SHEET #3

SAMPLE LOAN PACKAGE
PROJECTIONS

Profit and loss:

Reasonable projections show that two lots will be sold and one house started by CRDC during the first month of business. In the next two months, one more lot will be sold each month, with the rate probably dropping to one every other month thereafter. Meanwhile, construction will be completed on a new home every four months. Thus, income will start at about $53,000 per month, but will drop to $25,000 to $39,000 per month. Income will be approximately $14,000 in those months after construction is complete until all home sites are sold.

However, the majority of development costs will be early in the project. By completing all tract development in the first year, total expenses should be approximately $476,000, including payment on the loan. Income will produce $412,000 (on assumption that three houses will be built by the construction division). This would lead to a loss of $64,000 in the first year.

During the second year, costs will be greatly reduced, totaling about $145,000. During the same period, income should reach approximately $256,000. Thus, profits in the second year would be at least $111,000.

In the third and final year of development, at least $28,000 will be made from the sale of land. Another $40,000 to $60,000 is possible if the construction division continues to build homes in the development.

Cash flow:

During the first year, monthly expenditures will be approximately $63,000 for the first two months, dropping to $43,000 in the following two months and then to $33,000 for the remainder of the year when development will be completed. In the second year, expenses will run about $20,000 to $23,000 per month, except for the month in which the loan balloon payment is made. Expenses after that will be only those associated with construction costs.

Income averages $25,000 to $39,000 per month as long as the construction division is building homes.

Projections one year from the date of loan:

Assets—Land and improvements	$298,000.00
Liabilities—Balance of loan	$85,000.00
Net worth	$213,000.00

STARTING A BUSINESS
UNIT III

ASSIGNMENT SHEET #4 — EXPLORE PROBLEMS FACED BY ENTREPRENEURS IN OPERATING A BUSINESS

NAME ____ SCORE ________________

Starting and operating a business is a complicated undertaking that can lead to rewarding success or disappointing failure. Usually the failures are a result of poor planning or inadequate preparation. Often it is difficult to prepare for some of the situations that you may face because businesses are subject to the rise and fall of the economy, good and bad weather, support or lack of support from other businesses, fair and unfair treatment by individuals, and many other factors.

In this assignment sheet you will be presented with several case studies of businesses in trouble. The problems generally result from one of the factors discussed in Section II of the Information Sheet that contribute to the success or failure of a business. Part I of this assignment sheet discusses those factors further. Read the material in Part I and then go to the case studies in Part II. For each problem, identify the factor or factors that led to the problem. Then suggest a way the problem might have been avoided, such as by suggesting an agency that could have helped the entrepreneur prepare for the problem.

PART I

A. Management factors

1. Personal qualifications

(NOTE: It is doubtful that a person would possess all of the personal qualifications desirable for good management. However, a person may build on strong areas and try to improve the weak ones. Weak areas can be improved by attending conferences and courses, reading literature in these areas, and observing those with strong qualifications.)

a. Willingness to work long hours

b. Desire to learn

c. Ability to bounce back after a setback

d. Willingness to take risks

e. Ability to get along with others

f. Ability to communicate

g. Ability to sell

h. Ability to lead

ASSIGNMENT SHEET #4

i. Ability to make decisions

j. Ability to organize

2. Professional qualifications

a. Management knowledge

b. Technical knowledge

c. Ability to develop plans and objectives

1) Financial planning

(NOTE: A good financial plan should provide profit objectives as well as sales objectives for various major expenses.)

2) Organizational planning

(NOTE: An effective organizational plan allows for maximum productivity with little or no duplication of effort.)

3) Projects and activities planning

(NOTE: Every small business must take time to plan for the future, prepare necessary schedules and procedures, and make decisions about new activities that should be started.)

B. People factors

1. Recruiting, interviewing, and selecting personnel

a. Recruiting sources

EXAMPLES: State employment services, private placement services, educational facilities, general public

b. Interviewing skills

(NOTE: These skills determine how well a business can select the best employees from those available in the labor market.)

2. Personnel practices

(NOTE: These practices determine to a large part how people will be motivated to devote their full capabilities for the benefit of a business.)

a. Pay and fringe benefits

EXAMPLES: Holidays, life insurance, sick leave, vacation, health insurance, retirement

ASSIGNMENT SHEET #4

b. Working conditions

c. Grievance procedures

d. Positive discipline

e. Administrative procedures

EXAMPLES: Keeping payrolls prompt and accurate; keeping employees informed about fringe benefits; assisting employees in filing of health insurance claims and worker's compensation claims; scheduling vacations; organizing work

f. Training

C. Money factors

1. Capital and sources

(NOTE: Rarely does an owner or group of owners have enough money to conduct all the affairs of a business. For this reason, people must borrow money. Sources of money beyond personal savings include banks, savings and loans companies, the Small Business Administration, and private investors.)

2. Financial management

a. Analysis of financial statements

EXAMPLES: Income statement, expense statement, balance sheet

b. Tax management

3. Pricing and credit

(NOTE: Pricing has a great influence on the volume of business and on the profitability of that volume; credit when closely controlled can be used to increase sales, open markets to new buyers, facilitate selling, and satisfy customers.)

4. Budgets, cost controls, and records

(NOTE: These items must include labor cost by operation, material cost, waste, damage, scrap, and markdowns if the business is to record profit or loss accurately.)

D. Market factors

1. Market and market objectives

a. Analysis of the product or service

b. Definition of the market

c. Sources of supply

d. Competition

ASSIGNMENT SHEET #4

e. Location

f. Layout

2. Marketing plan

a. Direct sales effort

(NOTE: In a business where customers come to buy the product, it is important to train salespeople properly so that they know the product and how to approach customers. In a business where sales are achieved by contacting customers outside the business, it becomes important to decide whom to see, in what order, and how much effort to spend on each customer.)

b. Advertising and promotion

(NOTE: Advertising and promotion can be very useful in attracting customers to the goods or services offered by a business. However, it may be expensive and should be carefully organized so that it will reach the public with the right message at the right time. Advertising must also occur frequently enough so that the desired results will be achieved.)

PART II — Case Studies

A. Joe Bryan has decided to build homes on speculation. He has purchased a lot and begun construction of a house. One evening after Joe's crew has gone home, a group of children begin playing on the construction site. A ten-year-old boy falls through a cutout in the roof decking that was made for a skylight. The little boy breaks his back, and his parents sue Joe for $350,000 for medical damages, pain and suffering, and mental anguish. Despite the fact that the children were trespassing, the court will probably rule against Joe.

Factor ____

Help ____

____

B. Alice Muggendorf has always wanted to live in the mountains. She decides one day to relocate her construction company to Colorado to take advantage of a building boom for condominiums near the ski areas. She chooses the town of Glacierview because it is within 50 miles of several ski areas and she figures that most skiers would be willing to drive for an hour to ski. Also, a check of the Glacierview phone directory shows that there are no condominiums in the area. However, on arriving in Glacierview, Alice discovers that the steep winding roads make it at least a three-hour drive to any ski areas and that several of the passes are closed for most of the winter.

Factor ____

Help ____

____

ASSIGNMENT SHEET #4

C. Chet Clinton runs a sheet metal shop. He has found that by hiring unskilled workers at minimum wages he is able to keep his labor expenses at a low level and make more profit on his jobs. Soon, however, Chet notices that his business has dropped substantially and that his profits are quickly vanishing. When he studies his records, he sees that he has made sales to almost every builder in town, but that very few of them ever buy from him more than once or twice. When he examines the production records, he sees that none of his workers has been with him for more than a year. This does not bother him at first, but then he notices that during a worker's first five to six months, the worker produces at a rate of only 60 to 80 percent of that same worker's production at the end of a year.

Factor ____

Help ____

____

D. Bill Davis builds custom houses. He has made it a policy never to start a new job until the previous house is completed. He feels that he can manage one job, but believes that working on two jobs at one time would be confusing and difficult to coordinate, especially because he has to spend so much time on the job site supervising the crew. Last month, Bill had two families wanting him to build for them, but he asked them to wait until the house that he was working on was finished. Now that that job is complete, he is ready to start a new house. However, both families found other builders and now construction has slowed due to rising interest rates. If Bill does not contract for a new house soon, he will have to lay off his crew.

Factor ____

Help ____

____

E. Melissa Carlisle runs a successful insulation company, using two full-time crews working with supervisors. Howard Randal is the supervisor of one of the crews, and Melissa is aware that he has a drinking problem. Despite the fact that customers have complained, crew members have quit, and a couple of fairly serious injuries have happened because of Howard's on-the-job drinking, Melissa is reluctant to take any action against Howard because he is a dedicated worker and has been with the company for almost twenty years, having started with Melissa's father.

Factor ____

Help ____

____

ASSIGNMENT SHEET #4

F. Tony Lucerno has found that no matter how much business his company does, it seems that they always need more money. Tony believes that it is important to use the latest and newest equipment and to pay best wages to get and keep good employees. His jobs are done with the best materials to keep his customers satisfied. He prides himself on finishing jobs on time, even if it means overtime for his workers. He believes that the real key to success is in doing a lot of business, so he is careful to keep his contract bids low so that his company will have plenty of work to do.

Factor ______________________________

Help ______________________________

____

FOC-141-A

STARTING A BUSINESS
UNIT III

ASSIGNMENT SHEET #5 — EVALUATE OWN POTENTIAL TO START A BUSINESS

NAME ______________________________ SCORE ______________

One of the most important things that prospective small-business owners can do to ensure business success is to have a good understanding of themselves. It is only through a close self-evaluation that individuals can identify their strengths and weaknesses and determine whether or not they are ready to go into business.

The questionnaire provided in this assignment should make you think about yourself, and about what you need to know to go into your own business. Depending on the type of business, one question may have more weight than another. A certain number of "Yes" or "No" answers, therefore, will not definitely indicate that you are ready to begin your own business. You should realize, however, that if any of these questions cause you to prepare yourself more thoroughly, you are less likely to have problems as you start your business.

PART I

Read each statement in the following questionnaire. Write an "X" in the appropriate blanks.

PERSONAL CONSIDERATIONS

Yes	No	
_____	_____	Common sense is one of my strong points.
_____	_____	I like to make my own decisions and try my own ideas.
_____	_____	I enjoy being challenged and thrive on competition.
_____	_____	I have willpower and self-discipline. I get things done on time and plan ahead.
_____	_____	I like to work, and understand that my own business will require me to work harder and longer—twelve to sixteen hours a day, probably six days a week, maybe even on holidays.
_____	_____	I have the energy to do all the work involved—lifting, hauling, working in a shop, standing, walking, talking, smiling, driving—that the day-to-day operation of this business will call for.
_____	_____	I realize that I cannot be all things to all people at all times but that this will be expected of me in my own business. I can withstand the strain such a situation will create for me.
_____	_____	I do not know everything. There are still things to learn, new ideas for me to consider. I can take advice from others.
_____	_____	I am adaptable. I am not so routine-bound or rigid that I cannot change if the business requires change.

ASSIGNMENT SHEET #5

FINANCIAL CONSIDERATIONS

Yes	No	
		I have a head for figures and have looked into my own—and the proposed business'—financial picture thoroughly, preparing all the necessary statements and projections with the help of my accountant, who will inform me of my financial progress.
		I have enough money to go into business and can get more from other sources—friends, family, life insurance company. My banker stands ready to give me counseling and advice.
		I know that my standard of living will be lowered for several months—even a year or two—until the business begins to show a profit.
		I know that I must repay my loan out of after-tax profits before I can see a return on my investment.
		I know that it is possible for me to lose my savings—as well as the money I borrow from others—and that even if the business fails, I must pay back all that I owe.
		I have always protected myself, my family, and my possessions with insurance and will continue to do so. My insurance agent will help me select the best protection for the business.

MARKETING CONSIDERATIONS

Yes	No	
		I know that my community wants, needs, and can support this business and that there are enough people with sufficient inclination to spend money for the goods or services I plan to supply.
		I have studied the strengths and weaknesses of my competition, and I know the marketable differences in my product or service.
		I know how to go about finding the right location for my business and will select the site only after thorough research.
		I have given a good deal of thought to how and where I can best advertise and promote my merchandise or services.

ASSIGNMENT SHEET #5

MANAGEMENT CONSIDERATIONS

Yes No

_____ _____ I realize that about 90 percent of business failures are caused by inexperience and poor management. I have several years' experience in this or a related business.

_____ _____ I know the methods a good manager can follow to improve a business and also the mistakes that can drive business away.

_____ _____ I am familiar with and know how to keep inventory records, record and report sales, withhold taxes for the government, and make out official employee and business records and forms.

_____ _____ I know that the employees are the vital link between the business and its smooth operation. My experience or education has prepared me for maintaining positive relationships with employees while obtaining results.

_____ _____ I know how to develop an assistant or "backup" person to run the business when I am not there.

_____ _____ I know what the trade association expects of me and what to expect of it.

_____ _____ I can make my place of business effective and attractive—and stay within the budget.

_____ _____ I know the suppliers and the assistance they can provide.

_____ _____ I know how to forecast sales and expenses and how to use this information to help my business become successful.

_____ _____ I know how to price my goods or services competitively, meet expenses, make the payroll, and still turn a profit.

_____ _____ I know how to control my inventory or production to coincide with peak and slack periods in the business.

_____ _____ I know how to collect past-due accounts without losing customers.

_____ _____ I know how to analyze financial operating statements and can use these as a tool for effective business management.

FINAL CONSIDERATIONS

Yes No

_____ _____ I am aware of the advantages of working for someone else rather than going into business for myself and have considered all the alternatives to entering business on my own.

ASSIGNMENT SHEET #5

Yes	No	
_____	_____	I have investigated the possibility of a franchise operation and know the advantages there might be to a franchising agreement.
_____	_____	I know the advantages—and disadvantages—inherent in a sole proprietorship, partnership, and corporation and know which form of business organization I will select. My attorney will help.
_____	_____	I am aware that I may fail. There is less than a 50-50 chance that I will still be in business two years from now, but it is worth it to me to try.

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ASSIGNMENT SHEET #5

PART II

Evaluate your ability to start a small business by analyzing your responses to the questionnaire in Part I.

A. What are your strengths and weaknesses in each of the major considerations for starting a small business?

STRENGTHS	WEAKNESSES
Financial	
Personal	
Marketing	
Management	

ASSIGNMENT SHEET #5

B. What steps should you take to improve your ability to own a small business?

C. Are there certain considerations over which you have no control? Explain your answer.

D. Are you ready to start a small business? Explain your answer.

STARTING A BUSINESS
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheets #1 through #3 — Evaluated to the satisfaction of the instructor

Assignment Sheet #4

Part I — Evaluated to the satisfaction of the instructor

Part II

A. **Factor** — Management; Joe has demonstrated his willingness to take a risk. His ability to bounce back from a setback will be tested through this situation.

   Help — Liability insurance would help in this situation. It is hoped that Joe has properly managed his business and invested in liability insurance.

B. **Factor** — Marketing; though Alice should have exercised better judgment as a manager by investigating the business move more thoroughly, her real problem results from a lack of a market for condominiums in the area. Alice assumed that such a market existed and ran into trouble when she relocated only to find that her condominium business will probably not be able to succeed in Glacierview.

   Help — A number of agencies and private businesses provide marketing studies to entrepreneurs. The SBA, chambers of commerce, local and state development agencies, and other organizations could have provided Alice with an accurate assessment of her chances of success.

C. **Factor** — Management; Chet has neglected his employees, putting immediate gains over the need to provide employees with adequate benefits. As a result, he has experienced frequent turnover among his employees, and the quality of his product has suffered.

   Help — The SBA could provide Chet with management improvement courses or direct him to schools or organizations that provide such training.

D. **Factor** — Management and money; Bill's policy cripples his business. If he is to succeed, he needs to acquire the skills necessary to manage more than one job at a time. Now he faces money problems as a result of the policy.

   Help — The SBA and schools offering business management courses can help Bill improve his confidence and his management skills. He will probably have to borrow money or restructure his company to overcome the money problems. The SBA and lending institutions may be able to help him resolve his money problems.

E. **Factor** — Management and people; Melissa's failure to take positive discipline with Howard is hampering her company's operation. She needs to remove Howard from such an influential position for the sake of the company. As an employee, Howard represents a people factor because he is not contributing to the company's success.

   Help — Melissa may turn to management advisors for help. She may want to try to solve this particular problem by seeking professional help for Howard.

ANSWERS TO ASSIGNMENT SHEETS

F. **Factor** — Management, money, and marketing; Tony's business philosophy is interfering with the company's success. He operates with high expenses while keeping profits low, and his profits are often consumed by unexpected equipment, labor, and materials costs. He is experiencing money problems because of the low margin of profit. He is probably experiencing a marketing problem also, despite his concern for customer satisfaction and quality work, because his competitors quite likely underbid him on many jobs because of their lower expenses. Many buyers base their decisions on price and may not be aware of the extras offered by Tony.

Help — Tony needs the help of management consultants from the SBA or training institutes. He may need a marketing study done to see how much people are willing to pay for the extras he offers. He will probably need help from an advertising firm or advertising media consultants to publicize the extras offered by his company. The solution to his money problems lies in a workable compromise between what his business philosophy requires and what the marketplace is willing to pay for.

Assignment Sheet #5 — Evaluated to the satisfaction of the instructor.

STARTING A BUSINESS
UNIT III

TEST

NAME ________________________________ SCORE ______________

1. Match to their correct definitions terms associated with starting a business. Write the correct numbers in the blanks.

______a. Money, buildings, machines, and investments that are used or available to make products or to provide services

______b. Personal or business possessions that a borrower assigns to a lender as a pledge of debt payment

______c. French word meaning "enterpriser"; a person who owns a business

______d. Contract to use an item without purchasing it

______e. Business that is independently owned and not dominant in its field of operation

______f. Federal agency established to assist small-business owners

1. Entrepreneur
2. Capital
3. Small business
4. Lease
5. Small Business Administration (SBA)
6. Collateral

2. List primary factors that contribute to the success or failure of a business.

a. ____

b. ____

c. ____

d. ____

3. List five sources of information and assistance available to small-business owners.

a. ____

b. ____

c. ____

d. ____

e. ____

TEST

4. Select from the following list specific advisors available from the Small Business Administration. Write an "X" in the blank before each correct answer.

   _____a. Construction crews

   _____b. Management consultants

   _____c. Loan administrators

   _____d. Accountants

   _____e. Contract locators

   _____f. Advertising agents

5. Describe sources of capital used by entrepreneurs.

   a. Owned capital — ______________________________

   ____

   b. Retained earnings — ______________________________

   ____

   c. Borrowed capital — ______________________________

   ____

(NOTE: Test questions 6 through 10 list the assignment sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

6. Examine expenses involved in starting a business.

7. Write a plan for small-business ownership.

8. Prepare documentation required for a loan application.

9. Explore problems faced by entrepreneurs in operating a business.

10. Evaluate own potential to start a business.

STARTING A BUSINESS
UNIT III

ANSWERS TO TEST

1. a. 2
   b. 6
   c. 1
   d. 4
   e. 3
   f. 5

2. a. Management
   b. People
   c. Money
   d. Market

3. Answer should include any five of the following

   a. Federal government agencies
   b. Chambers of commerce
   c. Community business development councils
   d. Business or trade associations
   e. Credit bureaus
   f. Better business bureaus
   g. Associations of business people
   h. Special libraries and information centers
   i. Business professionals
   j. Personal contacts

4. b, c, e

5. Description should include the following

   a. Money belonging to the entrepreneur
   b. Company profits used to expand the company
   c. Money obtained from lenders such as individual investors, banks, finance companies, and the SBA

6. Evaluated to the satisfaction of the instructor

7. Evaluated to the satisfaction of the instructor

8. Evaluated to the satisfaction of the instructor

9. Evaluated to the satisfaction of the instructor

10. Evaluated to the satisfaction of the instructor

INDUSTRY ORIENTATION
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss construction-related job opportunities and be able to apply for a job. The student will show this ability by completing assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List levels of training for construction-related jobs.
2. List job opportunities open to skilled construction workers.
3. Select from a list personal attributes or attitudes that an employer looks for in an employee.
4. List documents that an applicant may need to prepare when applying for a job and at time of employment.
5. Write a résumé.
6. Write a letter of application.
7. Complete an employment application.
8. Make an interview appointment by telephone for a construction job.
9. Write a follow-up letter or make a follow-up telephone call after interviewing for a construction job.
10. Complete an Employment Eligibility Verification (Form I-9).

INDUSTRY ORIENTATION
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Assignment sheets

      1. Assignment Sheet #1 — Complete a Personal Information Sheet

      2. Assignment Sheet #2 — Write a Résumé

      3. Assignment Sheet #3 — Write a Letter of Application

      4. Assignment Sheet #4 — Complete an Employment Application

      5. Assignment Sheet #5 — Make an Interview Appointment by Telephone for a Construction Job

      6. Assignment Sheet #6 — Practice Interview Questions

      7. Assignment Sheet #7 — Write a Follow-Up Letter or Make a Follow-Up Telephone Call After Interviewing for a Construction Job

      8. Assignment Sheet #8 — Compare Job Opportunities

      9. Assignment Sheet #9 — Complete an Employment Eligibility Verification (Form I-9)

   E. Answers to assignment sheets

   F. Test

   G. Answers to test

II. Instructor's guide

   A. Obtain materials needed to supplement unit.

      1. Films

         (NOTE: The following films are available on a free-loan basis to Oklahoma teachers. Oklahoma teachers may order the films from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364. Out-of-state teachers must order from the addresses accompanying the films.)

SUGGESTED ACTIVITIES

a. *Getting a Job Is a Job.* Color, 20 minutes, Dibie-Dash Productions, Inc., 1966. Available from Dibie-Dash Productions, Inc., 4949 Hollywood Boulevard, Suite 208, Hollywood, California 90027.

(NOTE: This film discusses self-analysis, data sheets, and job sources.)

b. *Your Job: Applying for It.* Color, 13 minutes 30 seconds, Coronet Films, 1968. Available from Coronet Films, 65 East South Water Street, Chicago, Illinois 60601.

(NOTE: This film discusses appearance, leads, and perseverance.)

c. *Your Job: Finding the Right One.* Color, 13 minutes 30 seconds, Coronet Films, 1968. Available from Coronet Films, 65 East South Water Street, Chicago, Illinois 60601.

(NOTE: This film discusses a plan of action for job hunting.)

d. *Job Interview: I Guess I Got the Job.* Color, 13 minutes, McGraw-Hill. Available from McGraw-Hill Films, 110 Fifteenth Street, Del Mar, California 92014.

(NOTE: Through flashbacks, this film views approaches of two applicants for a job.)

e. *Get the Job: Line Up Your Interview.* Color, 11 minutes, Coronet Films, 1976. Available from Coronet Films, 65 East South Water Street, Chicago, Illinois 60601.

(NOTE: This film reviews how to write a résumé, choose a job objective, write a letter, and get a job.)

f. *Interview: Ready or Not.* Color, 24 minutes, Churchill Films, 1975. Available from Churchill Films, 622 North Robertson Boulevard, Los Angeles, California 90069.

(NOTE: This film explores the importance of a good self-concept during a job interview.)

2. Films and teaching kit—*Critical Steps of Job Interviewing.*

(NOTE: This kit consists of a 16 mm film, five cassettes, and programmed learning notebooks. It is available for purchase from Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364.)

SUGGESTED ACTIVITIES

3. Pamphlets

   a. *How to Get and Hold the Right Job*

   b. *How to Prepare Yourself for Job Interviews*

   c. *How to "Sell Yourself" to an Employer*

   (NOTE: All the above pamphlets are available from the nearest state employment service office.)

   d. *Appointment with Tomorrow.* Available from Vaseco, Inc., 2301 Classen Boulevard, P.O. Box 60274, Oklahoma City, Oklahoma 73106.

   e. *How Not to Blow a Job Interview.* Pamphlet available free from Army Reserve recruiter. U.S. Government Printing Office, 1978.

   f. *Making the Most of Your Job Interview.* Pamphlet available free from New York Life Insurance Company, 51 Madison Avenue, New York, New York 10010.

4. Competency profiles

   (NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or from The Associated General Contractors of America, 1957 E. Street, N.W., Washington, D.C. 20006 Phone 202-393-2040.)

B. Introduce the unit by discussing the variety of jobs available in the construction industry, emphasizing those that require skills taught in this course.

- Make a bulletin board display with ads and job notices for construction-related openings; also include Department of Labor or other agency forecasts for employment needs within the industry for the next few years.
- Make available books that describe various jobs in the construction trade.
- Obtain current statistics for your area or state on expenditures for construction, building permits, and so forth.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives, emphasizing how each objective relates to the course goal of qualifying the student for employment within the industry.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

SUGGESTED ACTIVITIES

1. Use Information Sheet, Section I, to acquaint students with the levels of training available in the construction trades.

   - Relate the levels of training to specific construction-related occupations.

   - Provide students with brochures and pamphlets from various types of building-trades training programs, such as those from colleges offering construction management programs.

   - Invite representatives from agencies involved in building-trades training to discuss their programs with the class. You may wish to take the class to some of the agencies so that students may view the training in progress.

2. Use Information Sheet, Section II, to discuss job opportunities available in the construction trades.

   - Emphasize those specialties that are prevalent in your area and those for which your program is most tailored.

   - Discuss the particular skills and tasks required for the specialties in which the students are particularly interested.

   - Invite workers from various construction jobs to talk to the class about the kind of work they do and what they like and do not like about their jobs.

3. Use Information Sheet, Section III, as an outline for discussing traits that an employer looks for in an employee.

   - Emphasize that the traits listed in Section III are helpful to any worker; relate the traits to specific actions and attitudes of skilled construction workers.

     EXAMPLES: A good construction worker should have a good set of tools and use and care for those tools properly.

     A good worker realizes that there is always more to learn and ways to improve; a good construction worker never tries to hide weaknesses in skills or knowledge.

     A good construction worker observes all safety rules, even if some of them seem stupid, because the worker realizes that there are sound reasons for each rule.

     A good construction worker is interested in doing a good job and takes pride in his or her work.

SUGGESTED ACTIVITIES

- Stress to the students that the traits listed in Section III will help them during their training in this program and in dealing with life's situations in general.

- Invite appropriate employers to the class to discuss the traits that they look for in potential employees and how they go about determining whether job applicants have those traits.

4. Review Information Sheet, Section IV, and use it as an introduction to the hiring process; discuss the hiring process and the documents that may be required in obtaining a job.

- Use Assignment Sheets #2, #3, #4, and #7 to reinforce proper format for résumé, letter of application, application form, and follow-up.

- Use Assignment Sheet #1 and #9 to allow students to practice completing forms. Emphasize the need for accuracy and neatness, and try to overcome any fears in students who are intimidated by forms.

- Use Assignment Sheet #5 to allow students to practice making an interview appointment by telephone. Stress that this call is the first contact an applicant may have with the firm.

- Take students to a state or private employment agency and allow the agency staff to explain their functions and services.

- Use the films and other supplements mentioned in this section to expand the Information and Assignment Sheets.

- Repeat Assignment Sheet #6 or similar interviewing role-plays in a variety of ways to allow the students to gain the most benefits.

  EXAMPLES: Videotape the interviews and allow the students to watch themselves; invite people with hiring responsibilities to act as the interviewer; allow the students to critique each other's interviews; change the questions.

- Use actual job notices and contact with actual employers to obtain the information necessary for Assignment Sheet #8; emphasize the many different factors besides salary that enter into an employment decision.

  EXAMPLES: Benefits, travel requirements, advancement opportunities, the sense of achievement, the chance to develop new skills

- Invite recent graduates of your program to talk to the students about what they discovered upon entering the job market, about what surprised them, about how this training prepared them, and about how their attitudes may have changed since the time they first entered training.

SUGGESTED ACTIVITIES

- Review this unit at the end of the course, or when students are ready to enter on-the-job training.

G. Review information.

H. Give test.

I. Complete appropriate section of competency profiles.

III. Unit reference

Hendrix, Laborn J. "Bud." *Fundamentals of Carpentry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1985.

INDUSTRY ORIENTATION
UNIT IV

INFORMATION SHEET

I. Levels of training for construction-related jobs

   A. Preparation

      EXAMPLES: Vocational/technical training, on-the-job, high school

   B. Apprenticeship

      EXAMPLES: Union, open shop

   C. Post-secondary

      EXAMPLES: College or university, technical school, business school

   D. Up-grading

      EXAMPLES: Open-shop training programs, special programs of materials and equipment companies, research and testing organizations, technical training schools

II. Job opportunities open to skilled construction workers

   A. Construction

      EXAMPLES: Carpentry, concrete masonry, bricklaying, ironworking, plumbing, sheet metal, drywall, roofing, insulation, welding

   B. Construction management

      EXAMPLES: Architect, structural engineer, estimator, safety engineer, supervisor, manager and planner

   C. Training

      EXAMPLES: Apprenticeship (union and open shop) instructor, vocational training center instructor, school shop teacher, equipment and materials instructor for workshops and seminars, writer

   D. Lumber, concrete, brick, metal, and insulation industries

   E. Prefabrication shops

   F. Remodeling, restoration, and maintenance

   G. Building materials and tool sales and service

INFORMATION SHEET

III. Personal attributes or attitudes that an employer looks for in an employee

  A. Enthusiasm and interest

  B. Dedication and dependability

  C. Alertness, quickness of mind

  D. Honesty and integrity

  E. Desire to work

  F. Knowledge and pride in the trade

  G. Desire to help others

  H. Desire to improve oneself

IV. Documents that an applicant may need to prepare when applying for a job and at time of employment

  A. Résumé

  (NOTE: A résumé is a brief summary of one's qualifications and work-related experiences.)

  B. Letter of application

  (NOTE: A letter of application states the applicant's interest in the position and shows the emloyer how the applicant will be useful to the business. A letter of application usually includes a copy of the résumé.)

  C. Job application

  (NOTE: A job application is a form on which the applicant provides specific information about his or her personal history, job history, job experience, education, and references.)

  D. Follow-up letter

  (NOTE: A follow-up letter is mailed after the interview to thank the interviewer for the interview and to refresh the interviewer's memory.)

  E. Form I-9

  (NOTE: This is a document implemented by the Immigration and Naturalization Service. When they actually begin work, new employees must fill out this form to verify employment eligibility.)

FOC-163-A

INDUSTRY ORIENTATION
UNIT IV

ASSIGNMENT SHEET #1 — COMPLETE A PERSONAL INFORMATION SHEET

NAME ______________________________ SCORE ____________

As you seek a job, you will be asked to complete various forms. You must always try to complete these forms neatly and accurately. Once you are hired, there will be other forms to fill out, usually including a form for personal information that may be necessary should the company need to contact your next of kin. Because of the jobs you will be performing in this program, such information will also be of use to your instructor.

Complete the following personal information sheet and hand in to your instructor.

Name ______________________ Class ______________________

Home Address ____

Home Phone ____

Parents' (Guardians') Names _______________________________

Parents' Occupations ______________________________________

____

____

____

Parents' Business Phones __________________________________

Place Where Parents Can Be Reached in Case of an Emergency ____________

____

Family Doctor ____

Shop Courses You Have Taken _______________________________

____

Trade Experience ____

____

Name of Insurance Company _________________________________

____

INDUSTRY ORIENTATION
UNIT IV

ASSIGNMENT SHEET #2 — WRITE A RÉSUMÉ

NAME ________________________ SCORE ____________

A good résumé should immediately give prospective employers a brief summary of your accomplishments, educational background, work experience, skills, and job objective.

Write a résumé, using accurate facts about yourself. Use the following information and the sample included in this assignment sheet as guides. It is not necessary to use the exact wording and outline form used on the sample, but it is necessary that your résumé be neat and balanced and contain all the information that might help you get a job.

Keep your résumé updated, and use it when you apply for jobs.

Guidelines for Writing a Résumé

A. Inspect several résumé formats and choose one that best fits your needs, or use the example included in this assignment sheet as a guide.

B. Type your résumé on 8½-by-11-inch white paper. Try not to exceed one page, but attempt to fill the page.

C. Spell correctly. Many employers will not consider persons whose résumés include misspelled words.

D. Put your name prominently at the center top or in the upper left-hand corner. Beneath your name, give full street address, city, state, ZIP code, telephone number with area code, and a number where messages can be accepted.

(NOTE: You may want to leave space to fill in your address on a printed résumé if you expect to change addresses.)

E. Do not include birthplace, age, health, height, weight, sex, marital status, photograph, salary, or reasons for leaving previous job. Avoid giving religious and political affiliations.

(NOTE: In general, the more information you are willing to share, the better; however, the whole point of the résumé is to interest employers in meeting you. The above information may or may not be asked during the interview. By not including this information, there is little or no chance for discrimination because of race, color, religion, sex, or national origin.)

F. Describe your job objective or career goal briefly. Do not restrict yourself to a specific job.

ASSIGNMENT SHEET #2

G. Describe your educational background, giving dates of enrollment, diplomas or degrees received, and names of schools attended. Include grade average (if favorable) and major course of study. If you include school grades, be sure that they are related to the jobs you have in mind.

(NOTE: Applicants with less than one year of work experience should list education before work experience; with more than one year, put experience first. In résumé writing, accentuate the positive, eliminate the negative. If pertinent, mention additional courses, scholarships, or summer school.)

H. List your past employment, starting with your most recent job. Carefully examine all of your jobs—including extracurricular activities. Concentrate on the skills; do not categorize "summer jobs."

(NOTE: The list should include the name of the company, your job title, and your major duties. The starting and termination dates for each job should also be listed.)

I. List skills useful to the job. Remember, you have to prove your value to the business, especially if you have little experience.

(NOTE: Use active verbs to indicate the specific tasks you performed, e.g. *built, assisted, operated.*)

J. Include the following information if it is relevant and if there is enough space: hobbies and interests, extracurricular activities, clubs, and awards you have received.

K. Ask at least three persons to serve as your references; ask yourself the kinds of recommendations they will give you.

EXAMPLES: Business references (previous employers and co-workers), school references (teachers), character references (minister, rabbi, neighbor who knows you well)

(NOTE: Avoid listing relatives unless you have actually worked for them on a salaried basis. Include addresses, titles, and phone numbers so that the prospective employers can contact your references.)

L. Write "CONFIDENTIAL" at the top of the résumé if you do not want your current employer to know that you are looking for employment.

M. Have a local printer retype your résumé and reproduce several copies. Request white bond paper.

(NOTE: The physical appearance of your résumé is *very* important. Avoid using ditto or carbon copies. Be sure to proofread the printer's work. Always take extra copies to the interview. Leave one copy of your résumé with the interviewer and use one as a reference when filling out the application form. You should also mail one résumé with your letter of application.)

ASSIGNMENT SHEET #2

SAMPLE RÉSUMÉ

RÉSUMÉ

Terry L. McKracken
774 East Adams Street
Anytown, Yourstate 77704
Phone: (800) 555-7779

September 3, 1987

Job Objective: Career in carpentry leading to position of construction manager

EDUCATION

1978-1982 Anytown High School, Anytown, Yourstate 77704
Activities: President of senior class
Career-related courses: Algebra, two semesters; geometry, two semesters; industrial arts woodworking, two semesters

1980-1982 Progress Vo-Tech, Progressville, Yourstate 77802
Activities: President of VICA
Honors: Carpentry contest, 1st place, state; 3rd place, national
Courses: Vocational carpentry, two years (1,080 hours); basic drafting, two semesters
Certificate: Carpentry, four semesters
Grade average: 3.5 on a 4.0 scale

WORK EXPERIENCE

1982— Jones Construction Company, Progressville, Yourstate 77802

Work as carpenter's helper; responsible for assisting with building layout, framing of exterior and interior walls, erecting trusses, installing sheathing, decking roofs, laying flooring, hanging drywall, installing exterior finish

1980-1981 Vocational Carpentry Class, Progressville, Yourstate 77802

As a student, built or assisted with all phases of construction; learned and observed basic safety and first-aid rules

1980-1981 Youth Fellowship Organization, Anytown, Yourstate 77704

Work as treasurer required planning and organization, written reports, math and accounting skills, and collection responsibilities

REFERENCES

Mr. John Naildriver
Construction Supervisor
Jones Construction Company
Progressville, Yourstate 77802
(800) 555-9578

Mr. Sammy Slavedriver
Vocational Carpentry Instructor
Progress Vo-Tech
Progressville, Yourstate 77802
(800) 555-0289

Ms. Jerry Smith
Youth Director
Parkview Church
711 Fellowship Circle
Anytown, Yourstate 77704
(800) 555-4307

INDUSTRY ORIENTATION
UNIT IV

ASSIGNMENT SHEET #3 — WRITE A LETTER OF APPLICATION

NAME ______________________________ SCORE ______________

The application letter is a sales technique to tell the employer how your abilities will be useful to the business. While the resumé gives general background information, the letter of application should specify your qualifications. Not all jobs require formal applications and interviews, but there are an increasing number of companies using these hiring techniques.

Cut a help-wanted ad for a construction job from the classified ad section of the local newspaper. Write an application letter to accompany the resumé you prepared in Assignment Sheet #2. Use as guides the following information and the sample letter at the end of the assignment sheet.

Guidelines for Writing a Letter of Application

(NOTE: If you cannot type, write or print neatly, using blue or black ink.)

A. Use acceptable form and appearance

   1. Type or write neatly
   2. Write on only one side of the paper
   3. Avoid smudges and typographical errors
   4. Use 8 1/2-by-11-inch white bond paper, not personal or fancy paper
   5. Spell, capitalize, and punctuate correctly
   6. Include employer's full name, title, and address
   7. Include your full name and address with ZIP code
   8. Retain a copy for further reference

B. Include proper information

   1. Write to a specific person

      (NOTE: Find out the name and the correct title of the person with hiring responsibility for the job that interests you. When in doubt, write to the top person who will refer your resumé to the right party. Use "To Whom It May Concern" if answering a blind ad.)

   2. Avoid excessive use of the pronoun "I"

ASSIGNMENT SHEET #3

3. Be brief

   a. Do not repeat all information that is in the résumé

   b. Avoid needless details

   c. Cover all points requested in the advertisement in exactly the order in which they were asked

   (NOTE: Some prospective employers make it a point of testing the applicant's ability to follow directions.)

4. State the position for which you are applying

5. State the reason(s) for your interest in the job

   (NOTE: Employers look for people who want future advancement opportunities rather than just a paycheck.)

6. Refer briefly to the main points in the attached résumé

7. Mention that persons listed on the résumé have given their permission to serve as references

8. Request an interview at the employer's convenience

   a. Tell where you can be reached

   b. Enclose a self-addressed envelope and your résumé

   c. Say that you will telephone next week

C. End the letter properly

(NOTE: "Sincerely" or "Very truly yours" is appropriate.)

D. Use your permanent address for the return address

E. Staple the letter to the résumé: they may be circulated to several departments and could become separated

F. A week later, follow up and telephone for an appointment

(NOTE: Do not be surprised if your résumé has been referred to another department. Remember, the company is in business, and you may not get immediate attention, especially if you sent a letter in response to a blind ad. Be persistent until you reach the right person, and then ask for a convenient date to set up an interview.)

G. Keep in touch regarding possible openings now and in the future

(NOTE: The job hunt may take several weeks or even months. It is important to keep your prospects active without being a nuisance.)

ASSIGNMENT SHEET #3

SAMPLE LETTER OF APPLICATION

774 East Adams Street
Anytown, Yourstate 77704
September 3, 198—

Mr. John Jones
Personnel Director
Jones Construction Company
Box 19
Progressville, Yourstate 77802

Dear Mr. Jones:

Please consider me for the job of rough framing carpenter that you advertised in the *Daily Chronicle*.

The skills I have learned in my high school vocational carpentry courses should qualify me for this job. I have had experience in all of the basic skills required in residential construction, including the safe use of power tools.

I graduated from high school in August, and I would like to become a carpenter. A more complete description of my qualifications is given in the enclosed résumé.

I would appreciate the opportunity to come and talk over this job opportunity at your convenience. I can be reached by telephone at 800-555-7779 after 3:30 or at the above address.

Sincerely yours,

Terry McKracken

Terry McKracken

Enclosure

FOC-173-A

INDUSTRY ORIENTATION
UNIT IV

ASSIGNMENT SHEET #4 — COMPLETE AN EMPLOYMENT APPLICATION

NAME ______________________________ SCORE ______________

This employment application will give you the opportunity to see what an application looks like and give you a chance to fill one out before you actually apply for a position.

Complete the following application form, using the guidelines below and information about yourself from your résumé.

(NOTE: Although each business uses its own form, general rules of preparation apply to any form.)

Guidelines for Completing an Employment Application

A. Be prepared

   1. Take a good ink pen

   2. Take copies of résumé

B. Look over the entire form before starting to write; do not hurry

C. Follow directions

   1. Note whether information is to be printed or written

   2. Carry out all directions

D. Write clearly, neatly, and legibly

E. Answer briefly

F. Be honest

G. Answer all questions

   (NOTE: If questions do not apply to you, write "Not Applicable" or "N/A" in the space to show that you did not overlook the question.)

H. Include complete information

I. Recheck application when finished

J. Avoid crossing out and erasing

K. Use the word "open" for question about minimum salary because most employers pay standardized rates and will not negotiate on salary

ASSIGNMENT SHEET #4

"WE ARE AN EQUAL OPPORTUNITY EMPLOYMENT COMPANY. WE ARE DEDICATED TO A POLICY OF NON-DISCRIMINATION IN EMPLOYMENT ON ANY BASIS INCLUDING RACE, CREED, COLOR, AGE, SEX, RELIGION OR NATIONAL ORIGIN OR PHYSICAL DEFECTS."

APPLICATION FOR EMPLOYMENT

LAST

PERSONAL INFORMATION

DATE

NAME
LAST FIRST MIDDLE

PRESENT ADDRESS
STREET CITY STATE ZIP

PERMANENT ADDRESS
STREET CITY STATE ZIP

PHONE NO SOCIAL SECURITY NUMBER

FIRST

REFERRED BY

EMPLOYMENT DESIRED

POSITION DATE YOU CAN START SALARY DESIRED

MIDDLE

ARE YOU EMPLOYED NOW? IF SO, MAY WE INQUIRE OF YOUR PRESENT EMPLOYER

EVER APPLIED TO THIS COMPANY BEFORE? WHERE WHEN

EDUCATION	NAME AND LOCATION OF SCHOOL	YEARS ATTENDED	DATE GRADUATED	SUBJECTS STUDIED
GRAMMAR SCHOOL				
HIGH SCHOOL				
COLLEGE				
TRADE, BUSINESS, OR CORRESPONDENCE SCHOOL				

SUBJECTS OF SPECIAL STUDY OR RESEARCH WORK

U.S. MILITARY OR NAVAL SERVICE RANK PRESENT MEMBERSHIP IN NATIONAL GUARD OR RESERVES

ACTIVITIES OTHER THAN RELIGIOUS (CIVIC, ATHLETIC, FRATERNAL, ETC.)

Exclude organizations, the name or character of which indicates the race, creed, color, or national origin of its members.

(CONTINUED ON OTHER SIDE)

FOC-175-A

ASSIGNMENT SHEET #4

FORMER EMPLOYERS (LIST BELOW LAST FOUR EMPLOYERS, STARTING WITH LAST ONE FIRST)

DATE MONTH & YEAR	NAME AND ADDRESS OF EMPLOYER	SALARY	POSITION	REASON FOR LEAVING
FROM TO				
FROM TO				
FROM TO				
FROM TO				

REFERENCES: Give below the names of two persons not related to you, whom you have known at least one year

NAME	ADDRESS	BUSINESS	YEARS ACQUAINTED
1			
2			

IN CASE OF EMERGENCY NOTIFY
NAME ADDRESS PHONE NO.

I AUTHORIZE INVESTIGATION OF ALL STATEMENTS CONTAINED IN THIS APPLICATION. I UNDERSTAND THAT MISREPRESENTATION OR OMISSION OF FACTS CALLED FOR IS CAUSE FOR DISMISSAL. FURTHER, I UNDERSTAND AND AGREE THAT MY EMPLOYMENT IS FOR NO DEFINITE PERIOD AND MAY, REGARDLESS OF THE DATE OF PAYMENT OF MY WAGES AND SALARY, BE TERMINATED AT ANY TIME WITHOUT ANY PREVIOUS NOTICE.

DATE SIGNATURE

DO NOT WRITE BELOW THIS LINE

TO BE COMPLETED DAY EMPLOYMENT BEGINS DATE

HEIGHT WEIGHT AGE DATE OF BIRTH

SINGLE MARRIED WIDOWED CITIZEN U.S.A. SEX

THE ABOVE INFORMATION NEEDED FOR PENSION, HOSPITALIZATION INSURANCE, ETC., AND NOT FOR HIRING PURPOSES

INTERVIEWED BY DATE REMARKS

NEATNESS		CHARACTER	
PERSONALITY		ABILITY	

HIRED FOR DEPT. POSITION WILL REPORT SALARY WAGES

APPROVED 1. 2. 3.
EMPLOYMENT MANAGER DEPT. HEAD GENERAL MANAGER

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA
AGC

INDUSTRY ORIENTATION
UNIT IV

ASSIGNMENT SHEET #5 — MAKE AN INTERVIEW APPOINTMENT BY TELEPHONE FOR A CONSTRUCTION JOB

NAME ______________________________ SCORE ______________

Making an appointment by telephone accomplishes two things. First, it shows that you are interested in saving the employer's time. Second, it shows that you are thoughtful enough to ask the best time for you to see the employer.

PART I

Read the following steps and reminders for making an interview appointment by telephone.

Guidelines for Making an Interview Appointment by Telephone

A. Steps in making an appointment

1. Plan what you are going to say before you call
2. State your name and reason for calling

   EXAMPLE: "Hello, this is Terry McKracken. I am calling about your ad for a construction worker that appeared in last night's paper. May I make an appointment for an interview?"

3. Ask when would be the best time for you to come for the interview, and ask for the name of the interviewer
4. Record the day, time, and place of the interview, and the name of the interviewer
5. Ask if you should pick up an application form or if they would like to send it to you before the interview
6. Thank the receptionist for the help

B. Things to remember

1. Remember that this call is the first contact you may have with the firm; make that first impression a good one
2. Keep the receptionist on your side; the receptionist is there to help you
3. Do not ask over the telephone how much the job pays
4. Be polite and courteous

ASSIGNMENT SHEET #5

PART II

Now that you have read about the correct way to arrange for a job interview, role-play a situation in which you make an interview appointment for a construction job by telephone. Use the checklist below to evaluate your performance.

	Yes	No
Was prepared before calling	☐	☐
Did not have to stammer to find the right words	☐	☐
Immediately identified self	☐	☐
Immediately stated reasons for calling	☐	☐
Asked the best time for an appointment with employer	☐	☐
Was courteous and friendly	☐	☐
Asked about picking up application form or having application form sent prior to interview	☐	☐
Thanked the receptionist	☐	☐
Made record of the interview date, hour, and place, and of interviewer's name	☐	☐

INDUSTRY ORIENTATION
UNIT IV

ASSIGNMENT SHEET #6 — PRACTICE INTERVIEW QUESTIONS

NAME ______________________________ SCORE ______________

An employer may not legally ask questions about an applicant's personal life. In fact, it is illegal for an employer to ask questions concerning a female applicant's maiden name; marital status; who lives with you; what church you attend or who your spiritual leader is; how many children you have, their ages, or who will care for them while you are at work; whether you rent or own your residence; whether you have ever had your wages garnisheed; or whether you have ever been arrested. However, many interviewers, particularly those in small businesses, sometimes ask such questions anyway. Whether or not you choose to answer such questions depends on how much you want the job.

The following questions are some that might be asked on an application form or during a job interview. Write an answer for each question. Keep this assignment sheet to review before going to an interview.

A. Why did you leave your previous job?

____

(NOTE: Try to be positive in stating your reasons for leaving a former job. Do not downgrade your previous employer.)

B. What did you like best about your job?

____

C. Are you in good health? ____________________________________

D. Do you intend to make this work your career? __________________

E. What are some of your special abilities?

____

____

F. What equipment do you operate?

____

____

G. How would you rate your training for this job? Very good? Fair? Why?

____

ASSIGNMENT SHEET #6

H. What personal characteristics do you think are needed to succeed in your vocation?

____

____

I. At what salary do you expect to start?____________________

J. How could you contribute to our organization?

____

____

____

K. Why should we hire you?

____

____

____

L. Tell us about your family and any plans for marriage or further education.

(NOTE: Remember, legally you do not have to answer this question. However, it is a good idea to have an answer.)

____

____

M. Have you applied for any other job?

____

N. Do you have any military obligations to fulfill?

____

O. Would you be able to work Saturdays and Sundays?

____

P. Does negative criticism disturb you?

____

ASSIGNMENT SHEET #6

Q. Would you be willing to relocate?

R. What size city do you prefer? Why?

S. Define *cooperation*.

T. How do you feel about working overtime?

REMEMBER: You never get a second chance to make a good first impression. Getting a job is a job!

INDUSTRY ORIENTATION
UNIT IV

ASSIGNMENT SHEET #7 — WRITE A FOLLOW-UP LETTER OR MAKE A FOLLOW-UP TELEPHONE CALL AFTER INTERVIEWING FOR A CONSTRUCTION JOB

NAME ____ SCORE ________________

It is sometimes helpful to return to a business and check again on possible job openings. This is often done about a week after the first interview. This short, casual visit accomplishes two things. It helps the interviewer remember you, and it shows that you have a sincere interest in working for that company.

It is not always possible to have this type of informal atmosphere when applying for a job. However, it is always proper to send a follow-up letter or to make a follow-up telephone call.

PART I

Write a follow-up letter thanking the employer for the interview. Use any form you wish, or follow the format of the sample follow-up letter included in this assignment sheet. Use the information below as a guide.

Guidelines for Writing a Follow-Up Letter

A. Make sure that your letter meets the following standards

   1. Typed or written perfectly

   2. Clean, neat, and attractively arranged on the page

   3. Free of spelling, punctuation, and grammatical errors

   4. Sent within a day or two after the interview

B. Include the following points in your follow-up letter

   1. Expression of appreciation for interviewer's time and interest

   2. Summary of your qualifications and interest in position

   3. Your name, address, and telephone number (to make it easier for your employer to contact you)

C. Make this last bid for the job a prime example of your excellent work habits; write a clean, neat, and well-worded letter

ASSIGNMENT SHEET #7

SAMPLE FOLLOW-UP LETTER

774 East Adams Street
Anytown, Yourstate 77704
September 3, 198—

Mr. John Jones
Personnel Director
Jones Construction Company
Box 19
Progressville, Yourstate 77802

Dear Mr. Jones:

Thank you for interviewing me for the construction job with your company. I feel that working for Jones Construction Company would be enjoyable and that I could do the general rough work that the job requires. I hope that I will have the opportunity to prove my worth.

The application form you gave me is enclosed.

I will be available for work October 15. You may call me at my home after 3:30 P.M. The number is (800) 555-7779.

Sincerely yours,

Terry McKracken

Terry McKracken

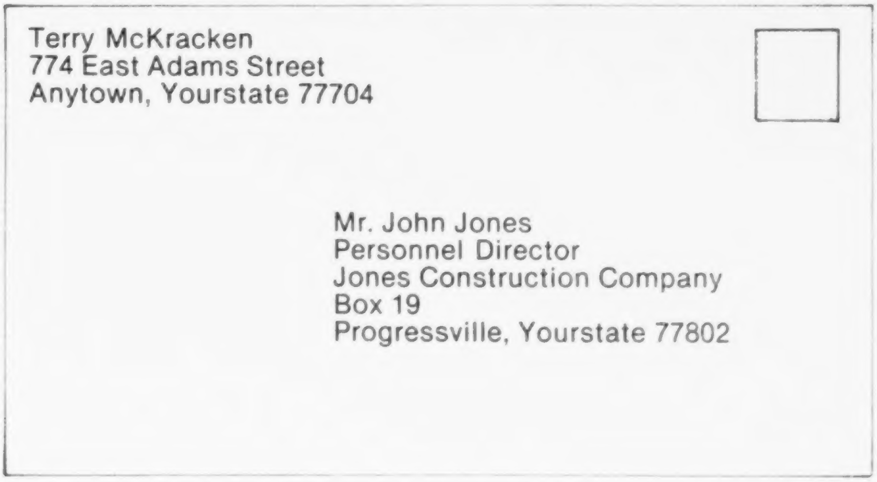
Enclosure

ASSIGNMENT SHEET #7

PART II

Address a legal-sized envelope and insert folded follow-up letter.

A. Type the address on the envelope exactly the same as the inside address of the letter

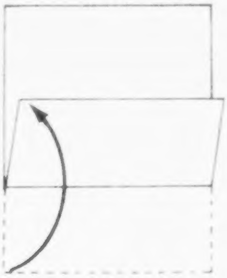


Terry McKracken
774 East Adams Street
Anytown, Yourstate 77704

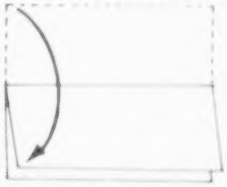
Mr. John Jones
Personnel Director
Jones Construction Company
Box 19
Progressville, Yourstate 77802

B. Fold letter

1. Fold slightly less than one-third of letter toward top

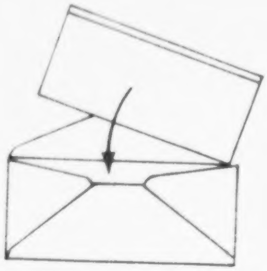


2. Fold down the top of letter to within ½ inch of bottom fold



ASSIGNMENT SHEET #7

C. Insert letter into envelope, with last crease toward bottom of envelope



PART III

Role-play a follow-up telephone call. Make sure to include the following information: your name, the date of your interview, and the position for which you were interviewed.

A. Ask whether a decision has been made

EXAMPLES:	Incorrect:	"Hello, Mr. Jones. This is Terry McKracken. You told me you would let me know about the job, but I haven't heard anything from you. Why haven't you called me?"
	Incorrect:	"This is Terry McKracken. Did I get the job?"
	Correct:	"Hello, Mr. Jones. This is Terry McKracken. I interviewed with you on September 15 for the position of construction worker. Have you made a decision on my application yet?"

B. If someone else has already been hired, thank the interviewer for considering you, but express continued interest in working for the company

EXAMPLES:	Incorrect:	"Oh well, that's my luck. Thanks anyway."
	Incorrect:	"I didn't want to work for your company anyway."
	Correct:	"I am sorry I was not hired. Thank you for considering my application. I am still interested in working for the company and would appreciate your keeping my application on file."

INDUSTRY ORIENTATION
UNIT IV

ASSIGNMENT SHEET #8 — COMPARE JOB OPPORTUNITIES

NAME ____________________ SCORE ____________

When you are offered a job, there are many factors to weigh before taking the position. Some of these factors include take-home pay, benefits that accompany the job, actual cost of being at work each day, how satisfying the job would be, and how the job would meet your needs and aspirations.

PART I

There are certain questions that you should ask yourself when weighing job opportunities. Part I of this assignment sheet outlines some of those questions. Using information from jobs for which you have applied or those in which you are interested, complete the following activities.

A. What benefits besides pay do I get from the job?

Some benefits associated with working are not always visible. Often some of these overlooked benefits are paid for in part by your employer. Obtain information about the benefits in the jobs you are considering. Be sure to note any benefits that must be paid for in part or completely by the employee. At the time of the interview, or when considering a position, ask about the following benefits:

1. Employer's contributions for your protection that may include
    - Health insurance
    - Unemployment compensation
    - Clothing and safety garments
    - Medical facilities and health tests
    - Pensions
    - Travel insurance (covering mishaps when traveling on business)
    - Educational programs or reimbursement for courses related to job
2. Sick leave with pay
3. Paid vacations and holidays

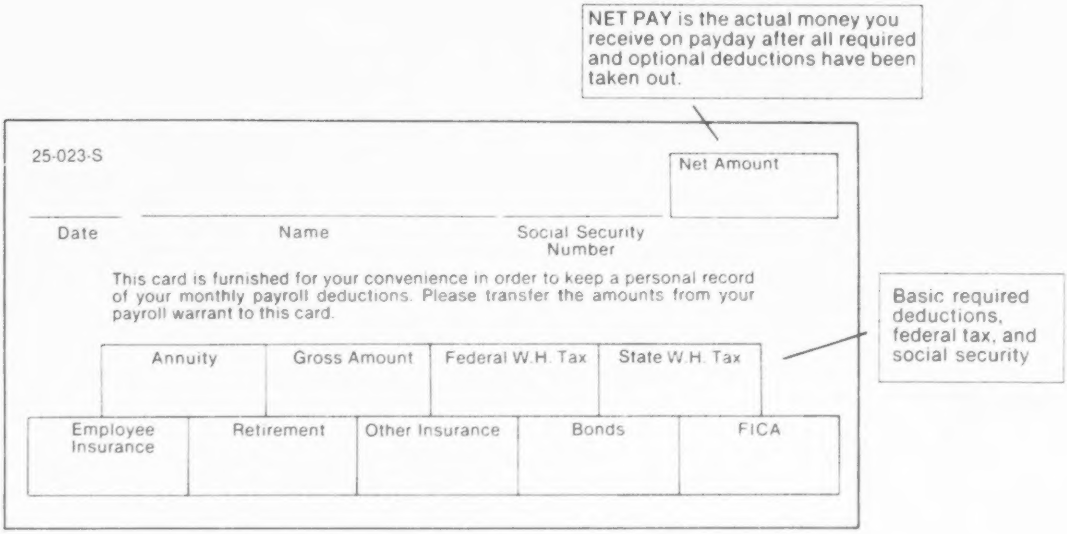
B. What is my take-home pay?

Salaries and wages are often quoted by employers as *gross earnings*. Gross earnings are used because tax deductions vary depending upon the number of dependents, the amount of earnings, and other information.

ASSIGNMENT SHEET #8

Optional benefits and deductions offered by an employer also differ. It is generally advisable to ask what programs are available, because such programs can affect the actual money you receive on payday.

Information about your earnings and withholdings is often recorded on a form such as the one shown below. Use the information about salary and payroll deductions provided by employers or by your instructor, along with tax information provided by your instructor, to determine take-home pay for the jobs you are considering.



NET PAY is the actual money you receive on payday after all required and optional deductions have been taken out.

25-023-S

Net Amount

Date ____ Name ____ Social Security Number ____

This card is furnished for your convenience in order to keep a personal record of your monthly payroll deductions. Please transfer the amounts from your payroll warrant to this card.

Annuity	Gross Amount	Federal W.H. Tax	State W.H. Tax

Employee Insurance	Retirement	Other Insurance	Bonds	FICA

Basic required deductions, federal tax, and social security

C. What will it cost to work at this job?

Frequently, the costs associated with being employed are overlooked. It may be of value to calculate estimated weekly expenses before making a decision about a job.

Estimate weekly expenses for

Transportation, gasoline (parking, bus fares) $______

Lunches (cost of food eaten away from home, including soft drinks and coffee) $______

Clothing (including cleaning) $______

Child care $______

Gifts for other employees $______

Special uniforms, materials, or equipment for job $______

Other $______

TOTAL $______

ASSIGNMENT SHEET #8

D. What is important to me in a job?

Take-home pay and benefits may be only part of what you want from a job. Think through other things you consider important in a job.

1. What have been some of your most rewarding job experiences? Why?

   a. ____

   b. ____

   c. ____

2. Rate the following in order of what is important to you, with "1" being the most important.

   ______a. Job security (little chance you will be released from the job)

   ______b. Opportunity for advancement

   ______c. Recognition for your work

   ______d. Good wages

   ______e. Opportunity to learn and use your ideas

   ______f. Flexible working conditions

   ______g. Long vacations

   ______h. Pleasant working conditions

   ______i. Interesting work

   ______j. Friendly co-workers

   ______k. Other, such as ____________________________________

PART II

To reach a decision about whether you want the job or not, summarize the information you have gathered.

A. Would the job be satisfying to me? Why or why not?

____

ASSIGNMENT SHEET #8

B. What are the benefits that accompany the job?

C. How much will it actually cost to be at work each day? ____________________

D. How would the job meet my needs and aspirations?

E. I estimate my take-home pay to be $____________________.

F. I estimate my expenses related to working to be $____________________.

G. I estimate my job benefits to be worth $____________________.

H. I would most enjoy the following about this job.

INDUSTRY ORIENTATION
UNIT IV

ASSIGNMENT SHEET #9 — COMPLETE AN EMPLOYMENT ELIGIBILITY VERIFICATION (FORM I-9)

NAME ________________________________ SCORE ______________

The Immigration Reform and Control Act of 1986 requires all new employees and their employers to complete Form I-9. The new employees complete the top half of the form on their first day of actual employment, and the employers normally have three business days to review their new employees' documents and to complete the bottom half of the form.

Complete the top section $\boxed{1}$ of the Form I-9 on the next page, using the guidelines below and information about yourself.

Guidelines for Completing Form I-9

- Be prepared
- Follow directions
- Write or print clearly, neatly, and legibly
- Answer all questions honestly
- Include complete information
- Recheck form when finished
- Avoid crossing out and erasing

When you are sure the form is correct and complete, hand it in to your instructor.

ASSIGNMENT SHEET #9

Top Section

EMPLOYMENT ELIGIBILITY VERIFICATION (Form I-9)

1 EMPLOYEE INFORMATION AND VERIFICATION: (To be completed and signed by employee.)

Name: (Print or Type) Last	First	Middle	Birth Name
Address: Street Name and Number	City	State	ZIP Code
Date of Birth (Month/Day/Year)		Social Security Number	

I attest, under penalty of perjury, that I am (check a box):

☐ 1. A citizen or national of the United States.
☐ 2. An alien lawfully admitted for permanent residence (Alien Number A ____________________).
☐ 3. An alien authorized by the Immigration and Naturalization Service to work in the United States (Alien Number A ____________________ , or Admission Number ____________________ , expiration of employment authorization, if any ____________________).

I attest, under penalty of perjury, the documents that I have presented as evidence of identity and employment eligibility are genuine and relate to me. I am aware that federal law provides for imprisonment and/or fine for any false statements or use of false documents in connection with this certificate.

Signature	Date (Month/Day/Year)

PREPARER/TRANSLATOR CERTIFICATION (To be completed if prepared by person other than the employee). I attest, under penalty of perjury, that the above was prepared by me at the request of the named individual and is based on all information of which I have any knowledge.

Signature		Name (Print or Type)	
Address (Street Name and Number)	City	State	Zip Code

ASSIGNMENT SHEET #9

---

2 EMPLOYER REVIEW AND VERIFICATION: (To be completed and signed by employer.)

Instructions

Examine one document from List A and check the appropriate box, ***OR*** examine one document from List B ***and*** one from List C and check the appropriate boxes. Provide the ***Document Identification Number*** and ***Expiration Date*** for the document checked.

List A
Documents that Establish
Identity and Employment Eligibility

☐ 1. United States Passport

☐ 2. Certificate of United States Citizenship

☐ 3. Certificate of Naturalization

☐ 4. Unexpired foreign passport with attached Employment Authorization

☐ 5. Alien Registration Card with photograph

Document Identification

# ______________________

Expiration Date (if any)

____

List B
Documents that Establish
Identity

☐ 1. A State-issued driver's license or a State-issued I.D. card with a photograph, or information, including name, sex, date of birth, height, weight, and color of eyes.

(Specify State) ______________________)

☐ 2. U.S. Military Card

☐ 3. Other (Specify document and issuing authority)

____

Document Identification

# ______________________

Expiration Date (if any)

____

and

List C
Documents that Establish
Employment Eligibility

☐ 1. Original Social Security Number Card (other than a card stating it is not valid for employment)

☐ 2. A birth certificate issued by State, county, or municipal authority bearing a seal or other certification

☐ 3. Unexpired INS Employment Authorization

Specify form

# ______________________

Document Identification

# ______________________

Expiration Date (if any)

____

CERTIFICATION: I attest, under penalty of perjury, that I have examined the documents presented by the above individual, that they appear to be genuine and to relate to the individual named, and that the individual, to the best of my knowledge, is eligible to work in the United States.

Signature	Name (Print or Type)	Title
Employer Name	Address	Date

Form I-9 (05/07/87)
OMB No. 1115-0136

U.S. Department of Justice
Immigration and Naturalization Service

INDUSTRY ORIENTATION
UNIT IV

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 — Completed to the satisfaction of the instructor

Assignment Sheet #2 — Completed to the satisfaction of the instructor

Assignment Sheet #3 — Completed to the satisfaction of the instructor

Assignment Sheet #4 — Completed to the satisfaction of the instructor

Assignment Sheet #5 — Completed to the satisfaction of the instructor

Assignment Sheet #6 — Completed to the satisfaction of the instructor

Assignment Sheet #7 — Completed to the satisfaction of the instructor

Assignment Sheet #8 — Completed to the satisfaction of the instructor

Assignment Sheet #9 — Completed to the satisfaction of the instructor

INDUSTRY ORIENTATION
UNIT IV

TEST

NAME ______________________________ SCORE ______________

1. List three levels of training for construction-related jobs.

   a. ______________________________

   b. ______________________________

   c. ______________________________

2. List five job opportunities open to skilled construction workers.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

3. Select from the following list personal attributes or attitudes that an employer looks for in an employee. Write an "X" in the blank before each correct answer.

   ______a. Personal grooming

   ______b. Knowledge of machinery

   ______c. Desire to work

   ______d. Alertness, quickness of mind

   ______e. Desire to improve one's financial status

   ______f. Enthusiasm and interest

   ______g. Knowledge and pride in the trade

   ______h. Dedication and dependability

   ______i. Desire to help others

   ______j. Honesty and integrity

TEST

4. List documents that an applicant may need to prepare when applying for a job and at time of employment.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

(NOTE: Test questions 5 through 10 list the assignment sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

5. Write a résumé.

6. Write a letter of application.

7. Complete an employment application.

8. Make an interview appointment by telephone for a carpentry job.

9. Write a follow-up letter or make a follow-up telephone call after interviewing for a construction job.

10. Complete an Employment Eligibility Verification (Form I-9)

INDUSTRY ORIENTATION
UNIT IV

ANSWERS TO TEST

1. Answer should include any three of the following
   a. Preparation
   b. Apprenticeship
   c. Post-secondary
   d. Up-grading

2. Answer should include any five of the following
   a. Construction
   b. Construction management
   c. Training
   d. Lumber, concrete, brick, metal, and insulation industries
   e. Prefabrication shops
   f. Remodeling, restoration, and maintenance
   g. Building materials and tool sales and service

3. c, d, f, g, h, i, j

4. a. Résumé
   b. Letter of application
   c. Job application
   d. Follow-up letter
   e. Form I-9

5. Completed to the satisfaction of the instructor

6. Completed to the satisfaction of the instructor

7. Completed to the satisfaction of the instructor

8. Completed to the satisfaction of the instructor

9. Completed to the satisfaction of the instructor

10. Completed to the satisfaction of the instructor

BECOMING A GOOD LEADER
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to list characteristics of a good leader and to name ways to become a good leader. The student will show this knowledge by completing assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Define *leadership.*
2. List characteristics of a good leader.
3. Name benefits of being a good leader.
4. Name ways to become a good leader.
5. Name traits of community leaders.

BECOMING A GOOD LEADER
UNIT V

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Assignment sheets

      1. Assignment Sheet #1 — Evaluate Leadership Qualities

      2. Assignment Sheet #2 — Name Traits of Community Leaders

   E. Answers to assignment sheets

   F. Test

   G. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials to supplement unit.

      1. Publications

         a. *Animal Science*. Columbia, Missouri: State Department of Education, Agricultural Education, University of Missouri, n.d.

         b. Gary, Jarrell D., and J.R. Jackson. *Leadership Training and Parliamentary Procedure for FFA*, Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1958.

         c. *Official Manual*. Alexandria, Virginia: Future Farmers of America, 1975.

      2. Competency profiles

         (NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or from The Associated General Contractors of America, 1957 E. Street, N.W., Washington, D.C. 20006; phone 202-393-2040.)

SUGGESTED ACTIVITIES

C. Introduce unit to students.

- Discuss good leadership.
- Have students make a list of some of the country's most popular leaders and what made them good leaders.
- Discuss with students their leadership potentials and why they would like to be leaders.

D. Provide students with unit.

E. Discuss unit and specific objectives.

F. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss the definition of leadership.
    - Discuss what makes a good leader and a poor leader.
    - Discuss the qualities it takes to be a good leader.
    - Discuss the leaders in your locality, training center, schools, churches, etc. and why they are good or poor leaders.
2. Use Information Sheet, Section II, to discuss characteristics of a good leader.
    - Have students review the information; then using the list that they made earlier, have them point out how many of the leaders above have all of the characteristics listed.
    - Ask students to evaluate themselves as to how many of these characteristics would fit them.
    - Have students complete Assignment Sheet #1.
3. Use Information Sheet, Section III, to discuss the benefits of being a good leader.
    - Invite a person who is a respected leader in your locality to come in and discuss the characteristics and benefits of being a good leader.
    - Have students complete Assignment Sheet #2.
4. Use Information Sheet, Section IV, to discuss ways to become a good leader.
    - Have students ask themselves, "How can I become a good follower?" "What are the qualities of a good leader?" "What are my own weak and strong points?" "How would I go about developing a plan to train myself as a leader?"

SUGGESTED ACTIVITIES

- Discuss each of their answers to each of the questions.
- Discuss with students any other ways to become a good leader.

G. Give test.

H. Critique test and discuss in class.

I. Reteach and retest if necessary.

J. Complete appropriate section of competency profiles.

III. Unit reference

Hendrix, Laborn J. "Bud." *Bricklaying Curriculum: Basic Core.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1983.

FOC-207-A

BECOMING A GOOD LEADER
UNIT V

INFORMATION SHEET

I. **Leadership** — Combination of qualities that inspires confidence, draws others toward the leader, and causes them to follow

II. Characteristics of a good leader

   A. Preparedness

   (NOTE: Leadership takes work as well as practice.)

   B. Group-mindedness

   (NOTE: Regard yourself as a part of the group. Say *we* instead of *I*. Do not try to run the group; instead, be guided by the group's wishes.)

   C. Consideration for others

   (NOTE: Be understanding and friendly.)

   D. Poise

   (NOTE: Do not let irritations bother you.)

   E. Humility

   (NOTE: Be confident, but not cocky. Do not be afraid to reveal that you do not know everything.)

   F. Hard work

   (NOTE: Do not ask anyone to do something that you would not be willing to do yourself.)

   G. Responsibility

   (NOTE: Live up to your work and duties.)

   H. Cooperativeness

   (NOTE: Know how to work with others and enjoy working with them.)

   I. Happiness

   (NOTE: Enjoy life — the simple things as well as the big things.)

INFORMATION SHEET

J. Imagination

(NOTE: Help the persons in your group learn and grow through the activities.)

K. Preciseness

(NOTE: Be able to express yourself effectively.)

L. Pride

(NOTE: Take pride in what you do. Take pride in being a leader, but earn it.)

M. Neatness

(NOTE: Always be neat in dress and personal appearance.)

N. Courtesy

(NOTE: The words *please* and *thank you* pay dividends; use them often.)

O. Understanding

(NOTE: Know members' opinions and be ready to meet changing situations.)

P. Ambition

(NOTE: Set goals and make them high, but be sure to reach them.)

Q. Open-mindedness

(NOTE: Take advice, but do your own thinking.)

R. Curiosity

(NOTE: Analyze all the facts before you draw conclusions.)

S. Energy

(NOTE: Do your best at all times. Plan to make the most effective use of your time.)

III. Benefits of being a good leader

A. Self-satisfaction

B. Challenge

C. Respect developed for others

INFORMATION SHEET

D. Maturation

E. Knowledge

F. Pride

G. Security

H. Skills needed in any field

I. Advancement in an occupation

J. Financial betterment

K. Respect of peers

IV. Ways to become a good leader

A. Become a good follower

B. Study qualities of a good leader

C. Evaluate own weak and strong points

D. Develop a plan for training oneself as a leader

BECOMING A GOOD LEADER
UNIT V

ASSIGNMENT SHEET #1 — EVALUATE LEADERSHIP QUALITIES

A good leader has many positive characteristics. People wanting to develop their leadership skills need to be aware of such positive traits and develop them. This assignment sheet will help you visualize what kind of leader you are.

Circle the appropriate number following each trait. Four is outstanding, three is above average, two is average, one is poor. Total your score on the following page.

(NOTE: Complete this as a personal evaluation, but do not hand in this assignment sheet.)

A.	Do I maintain a well-groomed appearance?	1	2	3	4
B.	Do I have a pleasing voice?	1	2	3	4
C.	Is my posture alert and poised?	1	2	3	4
D.	Is my disposition cheerful?	1	2	3	4
E.	Do I make friends easily?	1	2	3	4
F.	Do I exert a positive leadership?	1	2	3	4
G.	Am I generally thoughtful of the feelings of others?	1	2	3	4
H.	Is my enthusiasm sincere and contagious?	1	2	3	4
I.	Do I persevere until I achieve success?	1	2	3	4
J.	Am I sincere in my interest in other people?	1	2	3	4
K.	Am I ambitious to get ahead?	1	2	3	4
L.	Do I get along well with others?	1	2	3	4
M.	Do I react constructively to criticism?	1	2	3	4
N.	Do I remember names and faces?	1	2	3	4
O.	Am I punctual on all occasions?	1	2	3	4
P.	Do I have and show a spirit of cooperation?	1	2	3	4
Q.	Am I free from prejudice?	1	2	3	4
R.	Do I know how people react in most situations?	1	2	3	4
S.	Am I generally a good listener?	1	2	3	4

ASSIGNMENT SHEET #1

T.	Do I refuse to allow myself to be hurt by what other people say?	1	2	3	4
U.	Can I criticize without being offensive?	1	2	3	4
V.	Do I usually like people for what they are, or do I wait to see if they like me?	1	2	3	4
W.	Do I enjoy being part of a group?	1	2	3	4
X.	Am I reliable?	1	2	3	4
Y.	Can I adapt myself to all situations?	1	2	3	4
Z.	Am I easily discouraged?	1	2	3	4
AA.	Do I apply myself to the problems of each day?	1	2	3	4
BB.	Can I make a decision quickly and accurately?	1	2	3	4
CC.	Am I loyal to my superiors and associates?	1	2	3	4
DD.	Do I try to see the other person's point of view?	1	2	3	4
EE.	Am I neat and clean in my work as well as in my personal appearance?	1	2	3	4
FF.	Do I know where I make my mistakes, and do I admit them?	1	2	3	4
GG.	Am I looking for opportunities to serve others better?	1	2	3	4
HH.	Am I following a systematic plan for improvement and advancement?	1	2	3	4
II.	Can I accept honors and advancements and yet not become conceited?	1	2	3	4
JJ.	Am I playing the game of life honestly and fairly with myself and others with whom I work?	1	2	3	4

TOTAL SCORE ____________

Evaluate your own score — If your score totaled over 100, you have leadership potential. If you have been honest with yourself, you are among the people who are most likely to succeed as a leader. A score of 90 - 100 is above average; 75 - 90 is average; below 75 shows plenty of room for improvement. How did you rate?

BECOMING A GOOD LEADER
UNIT V

ASSIGNMENT SHEET #2 — NAME TRAITS OF COMMUNITY LEADERS

NAME ______________________________ SCORE ____________

One way to become a good leader is to observe a good role model. Most communities have leaders with excellent leadership qualities.

Select three individuals in your local community who seem to be good leaders. List three leadership traits for each individual.

NAME	LEADERSHIP TRAITS
A. ____________________	1. ____________________
	2. ____________________
	3. ____________________
B. ____________________	1. ____________________
	2. ____________________
	3. ____________________
C. ____________________	1. ____________________
	2. ____________________
	3. ____________________

BECOMING A GOOD LEADER
UNIT V

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 should not be evaluated by the instructor

Assignment Sheet #2 — Evaluated to the satisfaction of the instructor

BECOMING A GOOD LEADER
UNIT V

TEST

NAME ______________________________ SCORE ______________

1. Define *leadership.*

____

2. List five characteristics of a good leader.

a. ______________________________________

b. ______________________________________

c. ______________________________________

d. ______________________________________

e. ______________________________________

3. Name seven benefits of being a good leader.

a. ______________________________________

b. ______________________________________

c. ______________________________________

d. ______________________________________

e. ______________________________________

f. ______________________________________

g. ______________________________________

4. Name ways to become a good leader.

a. ______________________________________

b. ______________________________________

c. ______________________________________

d. ______________________________________

TEST

(NOTE: Test question 5 lists an assignment sheet. It is an important part of this test. If it has not been completed, check with your instructor.)

5. Name traits of community leaders.

BECOMING A GOOD LEADER
UNIT V

ANSWERS TO TEST

1. Leadership — Combination of qualities that inspires confidence, draws others toward the leader, and causes them to follow

2. Answer should include any five of the following

    a. Preparedness
    b. Group-mindedness
    c. Consideration for others
    d. Poise
    e. Humility
    f. Hard work
    g. Responsibility
    h. Cooperativeness
    i. Happiness
    j. Imagination
    k. Preciseness
    l. Pride
    m. Neatness
    n. Courtesy
    o. Understanding
    p. Ambition
    q. Open-mindedness
    r. Curiosity
    s. Energy

3. Answer should include any seven of the following

    a. Self-satisfaction
    b. Challenge
    c. Respect developed for others
    d. Maturation
    e. Knowledge
    f. Pride
    g. Security
    h. Skills needed in any field
    i. Advancement in an occupation
    j. Financial betterment
    k. Respect of peers

4. Answer should include the following

    a. Become a good follower
    b. Study qualities of a good leader
    c. Evaluate own weak and strong points
    d. Develop a plan for training oneself as a leader

5. Evaluated to the satisfaction of the instructor

JOB ADVANCEMENT
UNIT VI

UNIT OBJECTIVE

After completing this unit, the student should be able to list characteristics employers consider when deciding whom to promote. The student should also be able to name sources of additional education and training and be able to develop a program for self-improvement. The student will show this knowledge by completing the assignment sheet and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with job advancement to their correct definitions.
2. List characteristics employers consider in deciding whom to promote.
3. Select from a list ways good attitudes show on the job.
4. Discuss steps that will help in job advancement.
5. Select from a list benefits of additional education and training.
6. Name sources of additional education and training.
7. Discuss activities and/or commitments that will help prepare a person for advancement and responsibility.
8. Develop a program for self-improvement.

JOB ADVANCEMENT
UNIT VI

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Information sheet

  D. Assignment Sheet #1 — Develop a Program for Self-Improvement

  E. Answers to assignment sheet

  F. Test

  G. Answers to test

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Order competency profiles.

  (NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006; phone 202-393-2040.)

  C. Introduce unit to students.

  - Discuss job advancement.
  - Discuss why you would want to advance in your job.
  - Discuss benefits of advancing in your job.
  - Discuss sources and activities that could prepare yourself for advancement.

  D. Provide students with unit.

  E. Discuss unit and specific objectives.

  F. Discuss information and assignment sheets.

SUGGESTED ACTIVITIES

1. Use Information Sheet, Section I, to discuss terms and definitions.
    - Have students review terms and definitions.
    - Explain and discuss how understanding these terms and definitions will help them to understand this unit better.
2. Use Information Sheet, Section II, to discuss characteristics employers consider in deciding whom to promote.
    - Discuss the different characteristics listed in the information.
    - Have students evaluate themselves and each other as to how many of these characteristics would fit them.
    - Invite a contractor to the class to explain what characteristics he looks for when he decides on promoting a person. Have him discuss the characteristics in this unit and how he feels about them.
3. Use Information Sheet, Section III, to discuss ways that good attitudes show on the job.
    - Discuss good and bad attitudes in your class; explain how these attitudes will generally show up wherever you are.
    - Discuss how everyone would rather work with and around a person who has a good attitude.
    - Discuss how much better you feel about your job if you have the qualities that contribute to a good attitude.
4. Use Information Sheet, Section IV, to discuss steps that will help in job advancement.
    - Discuss all the steps listed that would help towards job advancement.
    - Have students evaluate themselves as to how many of these steps would fit them.
    - Encourage students to try to meet all of these standards.
5. Use Information Sheet, Sections V-VII, to discuss the benefits, sources, activities, and commitments that would help them towards job advancement and responsibility.
    - Discuss with students the benefits of additional education and training.
    - Encourage students to get more education and training.

SUGGESTED ACTIVITIES

- Discuss the different sources available for students to further their training.
- Have students check into these sources; volunteer to help the students in any way that you can.
- Discuss professional and civic organizations and projects that may help the students.
- Have students complete Assignment Sheet #1.

G. Give test.

H. Critique test and discuss in class.

I. Reteach and retest if necessary.

J. Interview and counsel students on their potential to begin an educational or training program.

K. Complete appropriate section of competency profiles.

III. Unit reference — Hendrix, Laborn J., "Bud." *Bricklaying Curriculum: Basic Core.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1983.

JOB ADVANCEMENT
UNIT VI

INFORMATION SHEET

I. Terms and definitions

   A. **Adaptability** — Ability to adjust easily to new situations

   B. **Cooperativeness** — Ability to work with others toward a desired goal

   C. **Goodwill** — Feeling of rapport and respect that has been established between individuals

   D. **Initiative** — Act of a self-starter, finding things that need to be done without having to be told

   E. **Perseverance** — Following a job through to its completion

II. Characteristics employers consider in deciding whom to promote

   (NOTE: These are not listed in order of importance.)

   A. Attitude

   B. Experience

   C. Quality of work

   D. Quantity of work

   E. Initiative

   F. Perseverance

   G. Cooperativeness

   H. Adaptability

   I. Ability to think

   J. Adequacy of training

III. Ways good attitudes show on the job

   A. Punctuality

   B. Dependability

   C. Sincerity

INFORMATION SHEET

- D. Loyalty
- E. Quality work
- F. Quantity work
- G. Pride in job
- H. Cooperativeness
- I. Aggressiveness
- J. Personal organization

IV. Steps that will help in job advancement

- A. Master present job completely
  - 1. Follow directions
  - 2. Ask questions when unsure
  - 3. Follow standard practices
  - 4. Meet deadlines
  - 5. Keep standards high
  - 6. Check quality of work
- B. Develop a program for self-improvement
  - 1. Improve personality
  - 2. Increase skills
  - 3. Continue education
- C. Show initiative on the job
  - 1. Take on additional responsibilities
  - 2. Handle more complicated work
  - 3. Suggest improvements

    (NOTE: Do not be overly ambitious at the expense of a more qualified person.)

INFORMATION SHEET

V. Benefits of additional education and training

   A. Advancement and job stability

   B. Better pay

   C. More exciting and challenging position

   D. Increased responsibilities

   E. Prestige

   F. Personal satisfaction

VI. Sources of additional education and training

   A. Postsecondary courses or classes

   B. Specialized courses

   C. Seminars and workshops for advanced training

   D. Colleges, junior colleges, and universities

   E. Adult education centers

   F. Local, state, and national conventions

VII. Activities and/or commitments that will help prepare a person for advancement and responsibility

   A. Reading

      1. Improving general knowledge

      2. Improving communication

      3. Enlarging areas of interest

      4. Keeping up-to-date in the field

   B. Joining professional organizations

   C. Being active in civic and community projects

JOB ADVANCEMENT
UNIT VI

ASSIGNMENT SHEET #1 — DEVELOP A PROGRAM FOR SELF-IMPROVEMENT

Professional workers cannot afford to discontinue their educational pursuits after high school graduation. They must constantly be working to improve their own personalities and skills. Professional workers have the responsibility to keep abreast in the field so that they will be able to suggest ways to reduce costs, increase efficiency, and stimulate profits. Good workers must also develop plans for self-improvement.

Hints for setting up a plan:

Select only a few items to work on at first; add additional items later as your schedule permits.

Set aside a certain time of the week for study and improvement. Do not be tempted to skip your improvement sessions.

Keep your plans simple enough that they do not interfere with your job by making you tired and sluggish.

Visit the public library often to review new books and periodicals.

Compare notes with friends who are working on similar plans.

Check into courses offered at local schools or universities.

Try to learn from others.

Finish each program that you start.

A. Complete the following questions.

1. In what personal areas are you weak? Grooming? Voice? Personality? List those areas in which you need improvement.

   ____

   ____

   ____

2. What skills do you have that need improvement? List them below.

   ____

   ____

   ____

ASSIGNMENT SHEET #1

3. Do you consistently try to improve your skills? ____________________

4. Do you do additional reading in those areas in which you are interested?

   ____

5. How many hours do you spend watching television per week (approximately)?

   ____

6. Could you devote one-third of this time to self-improvement? ____________

B. Make your plan for self-improvement.

1. Record, on a separate sheet of paper, how you spend your time each day for a week.

2. Review the way you spend your time.

3. List the specific hours you plan to spend during the week for self-improvement.

   ____

   ____

   ____

4. List three immediate goals you hope to achieve.

   a. ____

   b. ____

   c. ____

5. Outline your self-improvement plan for the next month, using the space below.

   ____

   ____

   ____

   ____

   ____

   ____

ASSIGNMENT SHEET #1

6. After one month of working on your individual improvement plan, review the results. What have you achieved? What had you hoped to achieve that you did not?

7. List the times you let something else take precedence over your self-improvement program.

JOB ADVANCEMENT
UNIT VI

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1 should be completed by the student but should not be evaluated by the instructor.

JOB ADVANCEMENT
UNIT VI

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with job advancement to their correct definitions. Write the correct numbers in the blanks.

______a. Act of a self-starter; finding things that need to be done without having to be told

______b. Ability to work with others toward a desired goal

______c. Feeling of rapport and respect that has been established between individuals

______d. Following a job through to its completion

______e. Ability to adjust easily to new situations

1. Adaptability
2. Cooperativeness
3. Goodwill
4. Initiative
5. Perseverance

2. List five characteristics employers consider in deciding whom to promote.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

3. Select from the following list ways good attitudes show on the job. Write an "X" in the blank before each correct answer.

______a. Punctuality

______b. Loafing

______c. Gossip

______d. Dependability

______e. Sincerity

______f. Doing sloppy work

TEST

_____g. Loyalty

_____h. Using company time for personal activities

_____i. Pride in job

_____j. Aggressiveness

_____k. Personal organizaton

_____l. Being late for work

_____m. Cooperativeness

4. Discuss steps that will help in job advancement.

a. Master present job completely — ____________________

____

____

____

____

____

____

b. Develop a program for self-improvement — ____________________

____

____

____

c. Show initiative on the job — ____________________

____

____

____

TEST

5. Select from the following list benefits of additional education and training. Write an "X" in the blank before each correct answer.

______a. Better pay

______b. College degree

______c. Prestige

______d. Advancement and job stability

______e. Personal satisfaction

______f. Increased responsibilities

______g. Less exciting and challenging position

6. Name four sources of additional education and training.

a. ____

b. ____

c. ____

d. ____

7. Discuss activities and/or commitments that will help prepare a person for advancement and responsibility.

____

____

____

____

____

____

____

(NOTE: Test question 8 lists the assignment sheet. It is considered an important part of this test. If it has not been completed, check with your instructor.)

8. Develop a program for self-improvement.

JOB ADVANCEMENT
UNIT VI

ANSWERS TO TEST

1. a. 4
   b. 2
   c. 3
   d. 5
   e. 1

2. Answer should include any five of the following

   a. Attitude
   b. Experience
   c. Quality of work
   d. Quantity of work
   e. Initiative
   f. Perseverance
   g. Cooperativeness
   h. Adaptability
   i. Ability to think
   j. Adequacy of training

3. a, d, e, g, i, j, k, m

4. Discussion should include the following

   a. Master present job completely

      1) Follow directions
      2) Ask questions when unsure
      3) Follow standard practices
      4) Meet deadlines
      5) Keep standards high
      6) Check quality of work

   b. Develop a program for self-improvement

      1) Improve personality
      2) Increase skills
      3) Continue education

   c. Show initiative on the job

      1) Take on additional responsibilities
      2) Handle more complicated work
      3) Suggest improvements

ANSWERS TO TEST

5. a, c, d, e, f

6. Answer should include any four of the following

   a. Postsecondary courses or classes
   b. Specialized courses
   c. Seminars and workshops for advanced training
   d. Colleges, junior colleges, and universities
   e. Adult education centers
   f. Local, state, and national conventions

7. Discussion should include the following

   a. Reading

      1) Improving general knowledge
      2) Improving communication
      3) Enlarging areas of interest
      4) Keeping up-to-date in the field

   b. Joining professional organizations

   c. Being active in civic and community projects

8. Evaluated to the satisfaction of the instructor

ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to practice safety on the job and perform basic first-aid treatment for accident victims. The student will show this knowledge by completing assignment sheets, job sheets, and unit test with a minimum score of 100 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with safety and basic first aid.
2. State reasons why you must be safety conscious on the job.
3. State consequences of a worker's using alcohol or drugs on the job.
4. State job safety rules.
5. Match colors of the safety color code to their correct applications.
6. Select correct definitions of terms associated with first aid.
7. State reasons why knowledge of first aid is important.
8. Arrange in order first-aid actions to follow in an emergency.
9. Demonstrate the ability to lift a heavy object properly.

DISCLAIMER

This is not a safety course or a first-aid course.

ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Supplements

    1. Supplement #1 — Safety and First-Aid Crossword Puzzle

    2. Supplement #2 — Types of Safety Equipment Used by Construction Workers

    3. Supplement #3 — How to Lift Safely

    4. Supplement #4 — Sample Safety Forms

  D. Information sheet

  E. Assignment sheet #1 — Visit a Job Site and Complete a Safety Checklist

  F. Answers to assignment sheet

  G. Job sheet #1 — Lift a Heavy Object Properly

  H. Test

  I. Answers to test

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Order or obtain materials to supplement unit.

    1. Films

      a. *Housekeeping Means Safe Keeping*. Color, 10 minutes, Journal Films, Inc., 1975. Available from Journal Films, Inc., 930 Pitner Avenue, Evanston, Illinois 60202.

      (NOTE: This film begins by taking the audience to a typical plant where they are presented with a variety of housekeeping violations. The dangers of these violations are then forcefully dramatized in the slow-motion recreation of a painful and realistic accident.)

      b. *A New Way to Lift*. Color, 9 minutes, Journal Films, Inc., 1970. Available from Journal Films, Inc., 930 Pitner Avenue, Evanston, Illinois 60202.

      (NOTE: This film, produced in conjunction with the National Safety Council, demonstrates body mechanics that apply to all lifting situations. By following these tips, students may avoid serious back injury.)

SUGGESTED ACTIVITIES

c. *The Industrial Weightlifter II*. Color, 11 minutes, Ruddel Films for Industrial Accident Prevention Association, Ontario and Canada Packers, Ltd., 1981. Available from International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Illinois 60604.

(NOTE: Visuals have been updated in this new version that illustrates correct techniques for lifting heavy objects to prevent injury.)

(NOTE: Films "d" through "g" in the following list are available to Oklahoma teachers on a free-loan basis. Oklahoma teachers may order these films from the Curriculum and Instructional Materials Center, Oklahoma State Department of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364. Out-of-state teachers must order from the addresses listed with the films.)

d. *An Option to See*. Color, 18 minutes, Oklahoma Society to Prevent Blindness, 1977. Available from Film Library, Oklahoma State Department of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.

(NOTE: This safety film stresses the importance of wearing safety glasses while working around machinery.)

e. *Don't Push Your Luck*. Color, 12 minutes, Harvest Films, Inc., 1978. Available from Harvest Films, Inc., 309 Fifth Avenue, New York, New York 10016.

(NOTE: In this film Bill Frank, an actual victim, recreates his real-life blinding accident. He delivers powerful safety messages to industrial employees and shows proper eye and face protection.)

f. *It's Up to You*. Color, 11 minutes, Harvest Films, Inc., 1960. Available from Harvest Films, Inc., 309 Fifth Avenue, New York, New York 10016.

(NOTE: This is an award-winning breakthrough film on eye safety.)

g. *On Every Hand*. Color, 10 minutes, Journal Films, Inc., 1970. Available from Journal Films, Inc., 930 Pitner Avenue, Evanston, Illinois 60202.

(NOTE: This film demonstrates how to avoid serious hand injuries that could be caused by commonly used and dangerous equipment.)

h. *How to Avoid 16 Leading Causes of OSHA Citations*. Color, 20 minutes, Bureau of Business Practice, 1978. Available from Bureau of Business Practice, 24 Rope Ferry Road, Waterford, Connecticut 06386.

(NOTE: This film shows the most common OSHA violations and tells how to avoid them.)

SUGGESTED ACTIVITIES

i. *Safety in the Shop: Basic Practices*. Black and white, 13 minutes, Coronet Films, 1970. Available from Coronet Films, 65 East South Water Street, Chicago, Illinois 60601.

(NOTE: This film emphasizes the worker's responsibility for safety in using hand and power tools. It explains the importance of a clean shop, proper clothing, correct ways to lift, and ways to guard against fires.)

j. *Danger Zone: Your Back*. Color, 18 minutes, Visucom Productions, 1981. Available from Visucom Productions, P. O. Box 5472, Redwood City, California 94063.

(NOTE: This safety film demonstrates good lifting, pulling, and pushing practices and is designed to motivate employees to participate in accident prevention.)

(NOTE: Films "k" through "q" and slide set "r" are available from Portland Cement Association, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077-9973.)

k. *Be a Pro*. 14 minutes, n.d., catalog number PC 146, rental only.

(NOTE: This film shows action shots of various sports that illustrate why professional players use the best equipment to protect themselves from injury.)

l. *Bend your knees*. 22 minutes, 1977, catalog number PC214, rental only.

(NOTE: This film shows proper lifting techniques to avoid back injuries.)

m. *Hazard*. 32 minutes, n.d., catalog number PC 140, rental only.

(NOTE: This film illustrates the importance of good work habits and carrying out instructions.)

n. *Inner Mind of Milton Whitty*. 19 minutes, n.d., catalog number PC 203, rental only.

(NOTE: In this film Whitty makes provocative statements about safety that apply to employers, supervisors, and workers.)

o. *Multiple Choice*. 24 minutes, 1976, catalog number PC 205, rental only.

(NOTE: The accident situations presented in this film involve road-construction and quarry-haulage mobile equipment.)

p. *Rigging Wire-Rope Slings*. 18 minutes, 1976, catalog number PC217, rental only.

(NOTE: This film explains conditions required for safe and proper rigging procedures.)

SUGGESTED ACTIVITIES

q. *Total Loss Control*. 10 minutes, 1972, catalog number PC210, rental only.

(NOTE: The message presented in this film points out that industry must direct its accident-protection efforts toward incidents that can result in injury, damage, or loss.)

r. *Occupational Respiratory Protection for Workers*. 51 slides, 11 minutes, 1979, catalog number CSO 17.092; includes carousel tray and tape cassette.

(NOTE: The slide set explains hazards, protective equipment, and preventive measure.)

s. *There's Something in the Air*. 30 slides with cassette, National Safety Council, n.d. Available from National Safety Council, P.O. Box 11933, Chicago, Illinois 60611, (312)5270-4800.

(NOTE: This program tells workers how to protect themselves from contaminated air—fogs, mists, fumes, gases, smokes, sprays, and vapors—that could be harmful to their lungs.)

2. Videotape and booklet concerning drugs and the workplace.

(NOTE: A video and a booklet are available from The Associated General Contractors of America [AGC], Publications Department, 1957 E Street N.W., Washington, D.C. 20006.)

a. *Drug-Free Workplace*, videotape, AGC, 1986, order number 161.

b. *Guide to Drug-Free Jobsites*, AGC, 1986, order number 160.

3. Safety signs, posters, and other films or filmstrips

(NOTE: Various safety educational material and filmstrips are available from Underwriters Laboratories, Inc., Public Information and Education Services, 207 East Ohio Street, Chicago, Illinois 60611.)

4. Audiovisual catalog

(NOTE: A catalog on training programs on diverse safety and health topics is available from National Audio Visual Center, National Archives and Records Administration, Customer Services Section CL, 8700 Edgeworth Drive, Capital Heights, Maryland 20743-3701.)

5. Full-color transparencies from the unit "Fire Behavior" in the IFSTA manual *Essentials of Fire Fighting*

(NOTE: This box of seventeen transparencies covering the burning process includes a plastic universal mount and an interleaf of each transparency for use by the instructor in a teaching outline. This set of transparencies is available from Fire Protection Publications, Oklahoma State University, Stillwater, Oklahoma 74078, or call toll-free 800-654-4055.)

SUGGESTED ACTIVITIES

6. Competency profiles and shop safety signs

   (NOTE: Competency profiles and shop safety signs for this book are available from The Associated General Contractors of America, 1957 E Street N.W., Washington, D.C. 20006, or from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.)

C. Introduce unit.

- Stress the importance of safety and first aid, particularly as related to the construction trades. Also explain to students that studies show there is a much greater risk for injury when students become comfortable in performing skills because they tend to become more careless.

- Explain how safe practices and habits may prevent injuries, loss of equipment, loss of materials, and may even save lives.

- Discuss the Good Samaritan Act by asking the following questions. Is the act practiced actively in your community? How actively is it practiced? What persons does the act specifically cover?

- Use instances of using first aid that you know of or have heard about, or use case studies, to point out the importance of knowing how to administer first aid.

D. Provide students with objective sheet. Discuss unit and specific objectives, pointing out that the safety and first-aid material in this unit is important enough to require a score of 100 percent on the unit test.

E. Provide students with information, assignment, and job sheets.

F. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I to introduce students to terms and definitions associated with safety.

   - Explain how knowing the terms and definitions will help the student understand and grasp the importance of this unit.

   - Have students review terms associated with safety and first aid by giving students Supplement #1, "Safety and First-Aid Crossword Puzzle." You may, however, want to delay using this supplement until all the sections in this unit have been reviewed.

2. Use Information Sheet, Section II, to discuss reasons why you must be safety conscious on the job.

   SUGGESTIONS:

   - Discuss how important it is to you and to your family, friends, co-workers, and employer that you be safety conscious on the job.

   - Have each student make a list of all the people who could be affected if an injury occurred to him or her while on the job. Then discuss how an injury to the head of a household could affect the future of each family member.

SUGGESTED ACTIVITIES

3. Use Information Sheet, Section III, to discuss consequences of a worker's using alcohol or drugs on the job.

    - Explain that alcohol or drug use on the job cannot be tolerated by employers because a drug or alcohol user becomes a safety threat to himself or herself and to fellow workers.
    - Explain the financial consequences of alcohol and drug use to the worker, to his or her family, and to the worker's company.
    - Quote appropriate statistics to support the ideas you have presented.
    - Make available to your students copies of the AGC publication *Guide to Drug-Free Jobsites*. Discuss in class.
    - Show the AGC videotape *Drug-Free Workplace*. Discuss it in class.

4. Use Information Sheet, Section IV, to discuss job-safety rules.

    - Use Information Sheet, Section IV, to discuss job-safety rules.
    - Discuss OSHA and other regulatory acts and agencies.
    - Show films, *Safety in the Shop: Basic Practices, Housekeeping Means Safe Keeping*, and *How To Avoid 16 Leading Causes of OSHA Citations*.
    - Demonstrate any safety procedures and explain any safety policies applicable to your specific equipment, shop, or job site.
    - Ask students to explain why personal and job-safety rules are important. Have them list possible consequences of not following these rules.
    - Stress the consequences of practical jokes on the job. Point out that employers do not want cheerless or humorless workers, but that they do want responsible employees who know the right time and place for humor. Explain how some people have lost their jobs because they engaged in horseplay or played practical jokes during working hours.
    - Explain how horseplay and practical jokes around power equipment increase the possibility of accidents.
    - Set up work schedules and shop clean-up procedures, and explain schedules and procedures to student. Post these schedules and procedures on the bulletin board.
    - Explain procedures for disposing of waste and scrap materials.
    - Discuss proper use of cleaning equipment and supplies, explaining special cleaning procedures or techniques specific to your equipment or shop.
    - Use Supplement #1, "Types of Safety Equipment Used by Construction Workers."

SUGGESTED ACTIVITIES

- Have students practice identifying job-site and shop safety violations by completing Assignment Sheet #1, "Visit a Job Site and Complete a Safety Checklist."
- Show films *A New Way to Lift*, *The Industrial Weightlifter II*, and *Danger Zone: Your Back*.
- Show students Supplement #3, "How to Lift Safely"; and then have them complete Job Sheet #1, "Properly Lift a Heavy Object."

5. Use Information Sheet, Section V to discuss the safety color code and its applications.
   - Ask if anyone in the class is colorblind (unable to distinguish between certain colors such as red and green). Take colorblind students on a special tour of the shop and work area, pointing out specific locations and applications for safety colors.
   - List colors of the safety color code, and have students find and list applications of each in the shop and at the work site.
6. Hand out copies of Supplement #4, "Sample Safety Forms" at your discretion. Have students read and complete the safety agreement, and then file. Have students complete the safety pledge, and then file.
7. Use Information Shee, Section VI, to introduce students to terms and definitions associated with first aid.
   - Explain how knowing these terms and definitions will help students understand and grasp the importance of first aid.
   - Have students review terms associated with first aid by completing Supplement #1, "Safety and First-Aid Crossword Puzzle."
   - Whenever possible, show students examples of the different terms used in first aid.
8. Discuss Information Sheet, Section VII, stressing the importance of knowing first aid.
   - Supplement your discussion with material from the American Red Cross books *Standard First Aid and Personal Safety* and *Multimedia Standard First Aid Student Workbook*. Encourage students to obtain their own copies of these manuals for home and work-site reference. Both manuals are available from the American Red Cross, 17th and D Streets, Washington, D.C. 20006.
   - Show films *An Option to See*, *Don't Push Your Luck*, *It's Up to You*, and *On Every Hand*.
   - Invite a resource person to speak to the class on first-aid techniques.
   - Encourage students to take American Red Cross cardiopulmonary resuscitation (CPR) and first-aid courses for certification.

SUGGESTED ACTIVITIES

- Tell students the local number for emergency medical service.

9. Use Information Sheet, Section VIII, to discuss the order to follow when giving first aid in an emergency.

G. Post appropriate warning signs and operating procedures near equipment.

H. Caution students that noncompliance with safety rules will result in disciplinary action.

I. Urge students to read and use supplement furnished with this unit.

J. Give test.

K. Critique test and discuss in class.

L. Reteach and retest if necessary.

M. Complete appropriate section of competency profiles.

III. Unit reference — Hendrix, Laborn J. "Bud." *Fundamentals of Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1981.

ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT I

SUPPLEMENT #1 — CROSSWORD PUZZLE

Test yourself on safety and first-aid terminology by using the clues below to complete the following crossword puzzle. Clue 57 Down has been done for you.

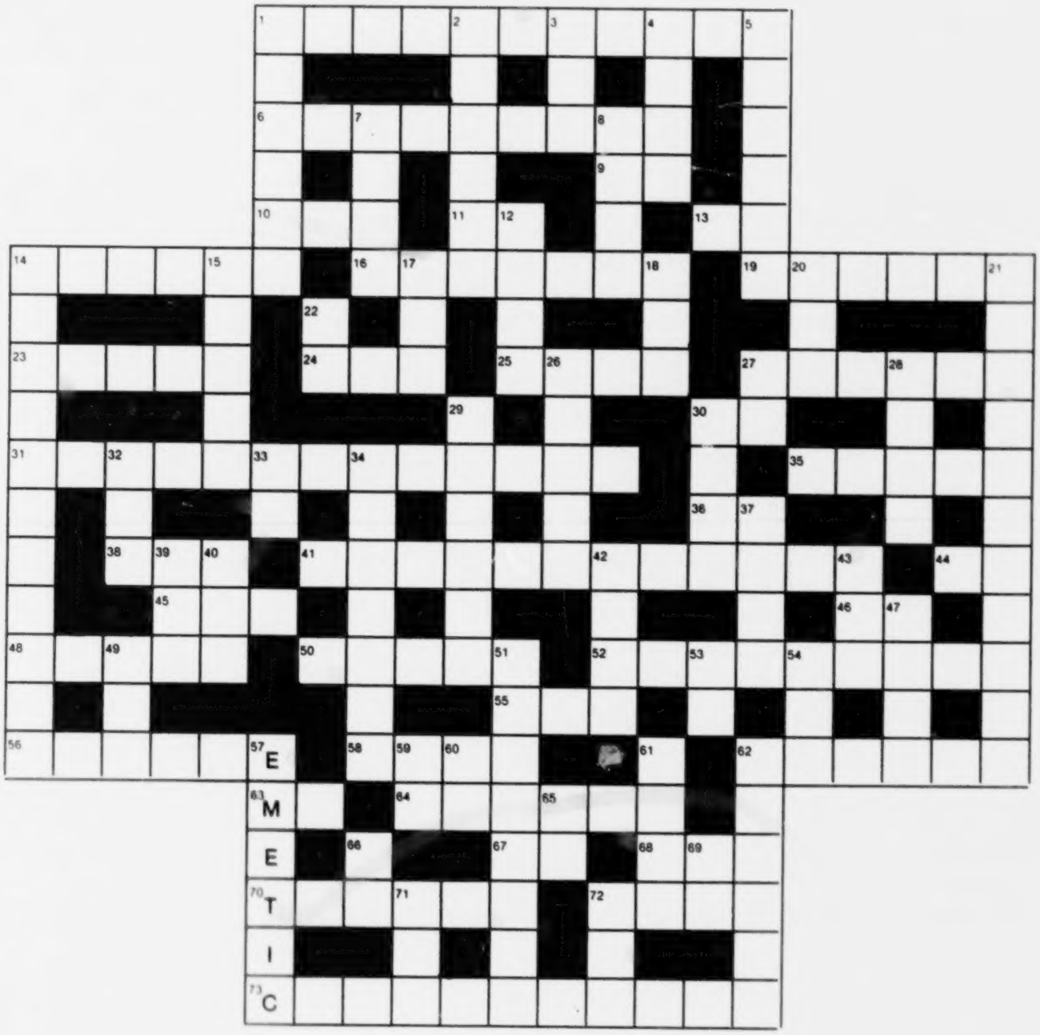
ACROSS

1. Guidelines for job safety (2 wds)
6. Suddenly occurring unintentional events that cause injury or property damage
9. Exists
10. Long, thin fish
11. Northwest Territories (abbr)
13. Atop
14. Source of danger
16. Intensity indicators for first-, second-, and third-
19. Muscular organ in mouth
23. Combustible substance in Class D fire
24. Cardiopulmonary resuscitation (abbr)
25. Fracture associated with open wound
27. Explode; burst violently (2 wds)
30. "To be or not to . . ."
31. Act of reviving a person by bringing person back to full consciousness
35. Television image
36. Route (abbr)
38. To put on
41. Negligence; failure to think before one acts
44. Rhode Island (abbr)
45. Word of negation
46. Pennsylvania (abbr)
48. Federal safety color designating location of first-aid equipment
50. Indication of fire
52. Capable of being easily ignited
55. Untruth
56. Life-threatening disorder caused by prolonged exposure to intense heat
58. Tender; painful
62. Freedom from danger, risk, or injury
63. Physician's degree
64. Resuscitate
67. Article
68. Health resort with mineral springs
70. Complaint of victim in shock from hemorrhage
72. Wound made by piercing with a sharp instrument
73. Capable of bursting into flames

DOWN

1. What all metal containers for flammable materials should be
2. "Good ----s to all"
3. The worst thing to do if your clothing or hair catches fire
4. Shock can be caused by — of blood
5. Device to prevent fractured bones and adjacent joints from moving
7. Water temperature for treatment of second-degree burn
8. To become in need of rest; to become weary
12. Group of three
14. Heavy losses of blood
15. Guidelines
17. Organ of hearing
18. Cause of 56 Across
20. Flammable liquid
21. Violently and loudly
22. Master of ceremonies (abbr)
26. What one should never do to an open fracture
27. To exist
28. Broad
29. Long, thin mark of different color than surrounding area
30. Injury caused by contact with heat, steam, electricity, or flame
32. Unhappy
33. Cubic centimeter (abbr)
34. Bodily injuries, wounds, or shocks
37. Group that works together toward a common goal
39. Unit
40. Prefix meaning *not*
42. Free of danger; secure
43. Identical twin of 68 Across
47. Capable
49. Ever (poetic)
51. Raises, as for an injured or bleeding limb
53. Fire extinguisher to use on flammable liquids and ordinary combustibles
54. Actress Farrow
57. Substance used to cause vomiting of some poisons
59. Either, —; neither, nor
60. Prefix meaning *again*
61. Inactivity after work or exertion
62. Not changing
65. Within; inside
66. Prefix meaning *two*
69. Father (slang)
71. Action that eases heat cramps
72. Science fiction; —fi

SUPPLEMENT #1



SUPPLEMENT #1

					1 S	A	F	E	2 T	Y	3 R	U	4 L	E	5 S					
					E	■	■	■	I	■	U	■	O	■	P					
					6 A	C	7 C	I	D	E	N	8 T	S	■	L					
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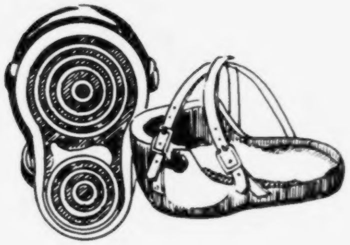
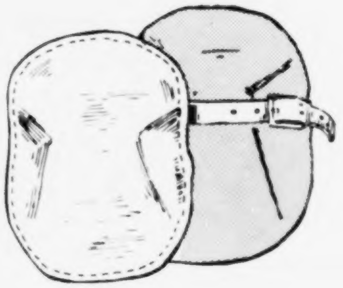
14 H	A	Z	A	15 R	D	■	16 D	17 E	G	R	E	E	18 S	■	19 T	20 O	N	G	U	21 E
E	■	■	■	U	■	22 M	■	A	■	I	■	■	U	■	■	I	■	■	■	X
23 M	E	T	A	L	■	24 C	P	R	■	25 O	26 P	E	N	■	27 B	L	O	28 W	U	P
O	■	■	■	E	■	■	■	■	29 S	■	R	■	■	30 B	E	■	■	I	■	L
31 R	E	32 S	U	S	33 C	I	34 T	A	T	I	O	N	■	U	■	35 V	I	D	E	O
R	■	A	■	■	C	■	R	■	R	■	B	■	■	36 R	37 T	■	■	E	■	S
H	■	38 D	39 O	40 N	■	41 C	A	R	E	L	E	42 S	S	N	E	S	43 S	■	44 R	I
A	■	■	45 N	O	T	■	U	■	A	■	■	A	■	■	A	■	46 P	47 A	■	V
48 G	R	49 E	E	N	■	50 S	M	O	K	51 E	■	52 F	L	53 A	M	54 M	A	B	L	E
E	■	E	■	■	■	■	A	■	■	55 L	I	E	■	B	■	I	■	L	■	L
56 S	T	R	O	K	57 E	■	58 S	59 O	60 R	E	■	■	61 R	■	62 S	A	F	E	T	Y
					63 M	D	■	64 R	E	V	65 I	V	E	■	T					
					E	■	66 B	■	■	67 A	N	■	68 S	69 P	A					
					70 T	H	I	71 R	S	T	■	72 S	T	A	B					
					I	■	■	U	■	E	■	C	■	■	L					
					73 C	O	M	B	U	S	T	I	B	L	E					

ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT 1

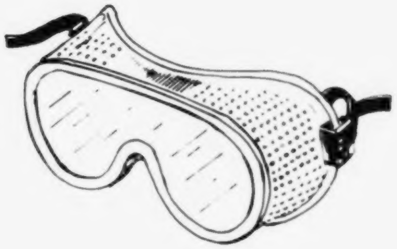
SUPPLEMENT #2 — TYPES OF SAFETY EQUIPMENT USED BY CONSTRUCTION WORKERS

Knee pads

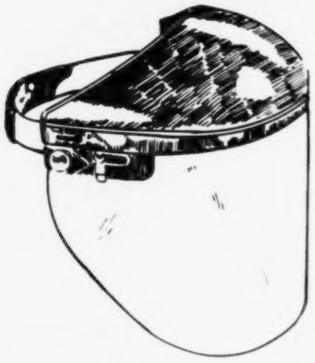




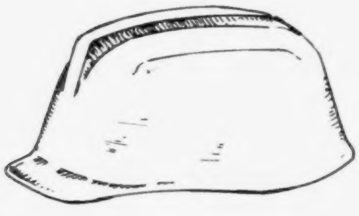
Goggles



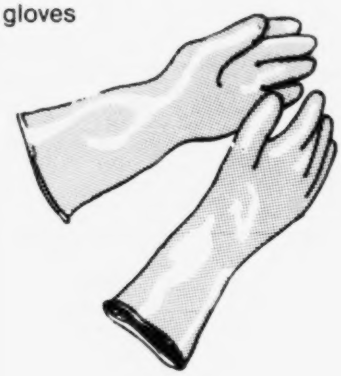
Face Shield



Safety helmet/hard hat

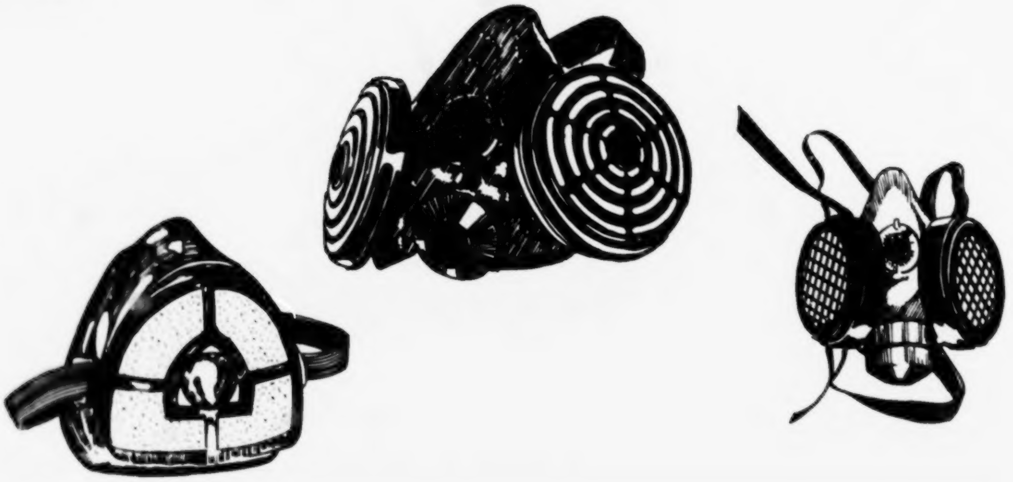


Rubber gloves

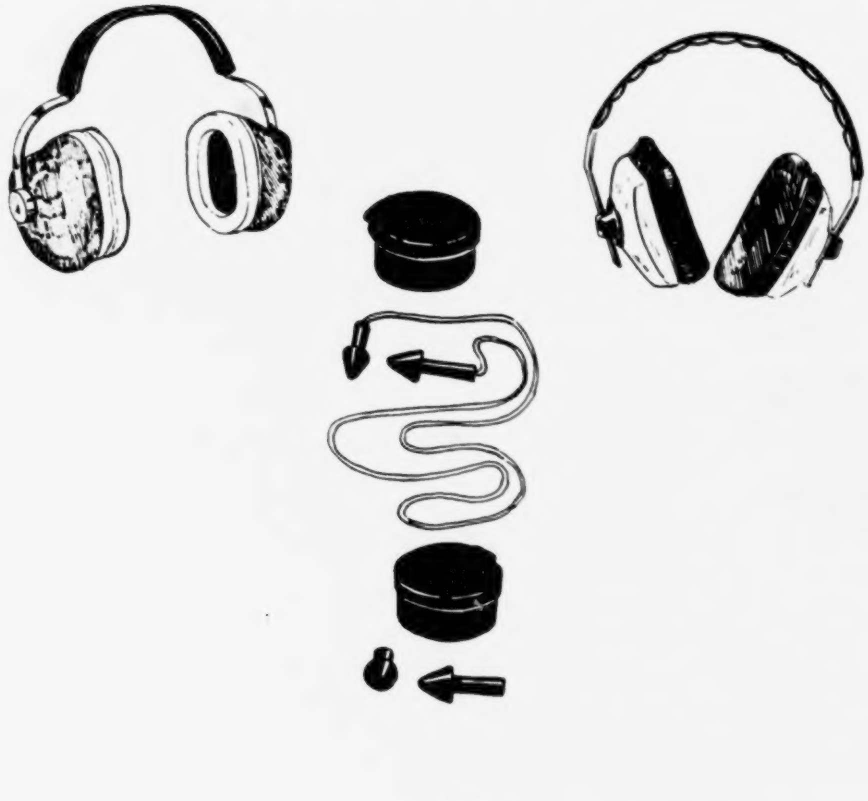


SUPPLEMENT #2

Respirators

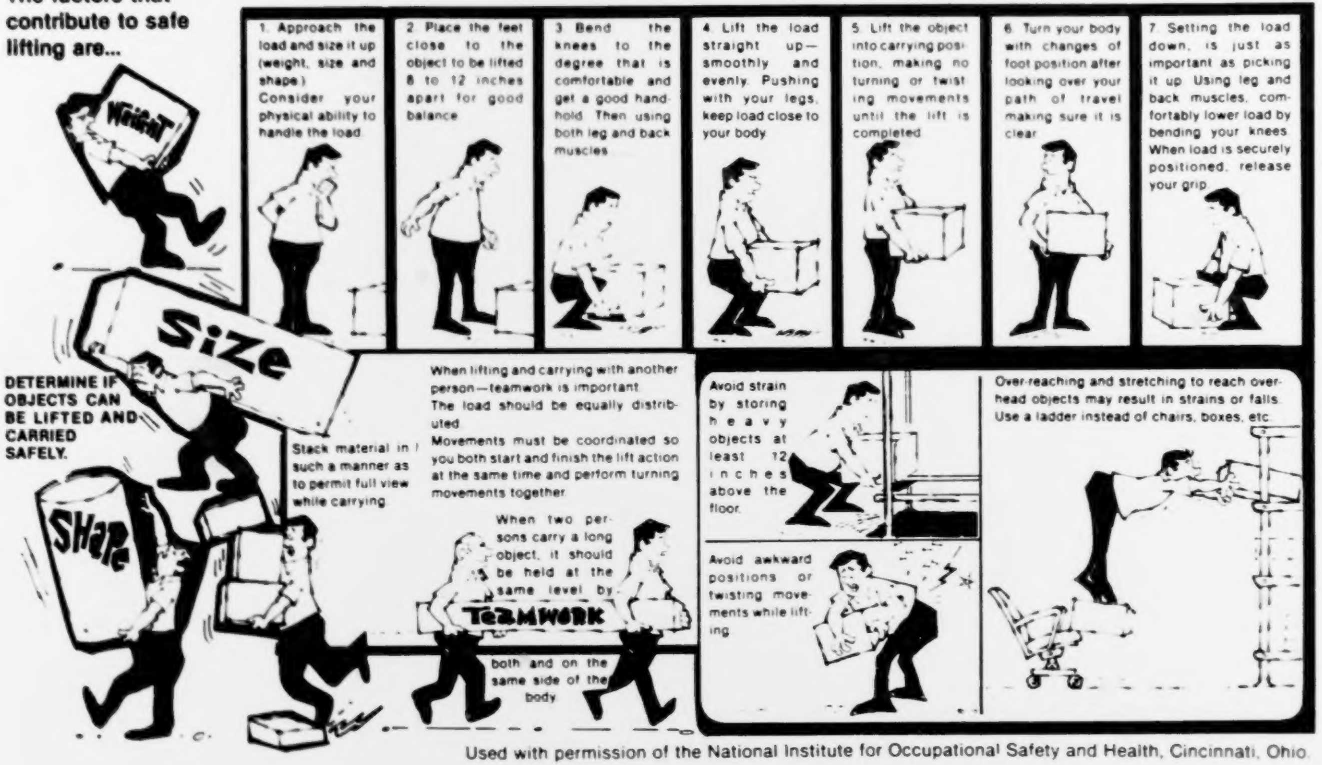


Ear protectors



HOW TO LIFT SAFELY

The following safe practices should be observed in order to avoid injury.



The factors that contribute to safe lifting are...

DETERMINE IF OBJECTS CAN BE LIFTED AND CARRIED SAFELY.

1. Approach the load and size it up (weight, size and shape.) Consider your physical ability to handle the load.

2. Place the feet close to the object to be lifted 8 to 12 inches apart for good balance.

3. Bend the knees to the degree that is comfortable and get a good hand-hold. Then using both leg and back muscles.

4. Lift the load straight up—smoothly and evenly. Pushing with your legs, keep load close to your body.

5. Lift the object into carrying position, making no turning or twisting movements until the lift is completed.

6. Turn your body with changes of foot position after looking over your path of travel making sure it is clear.

7. Setting the load down, is just as important as picking it up. Using leg and back muscles, comfortably lower load by bending your knees. When load is securely positioned, release your grip.

Stack material in such a manner as to permit full view while carrying.

When lifting and carrying with another person—teamwork is important.
The load should be equally distributed.
Movements must be coordinated so you both start and finish the lift action at the same time and perform turning movements together.

When two persons carry a long object, it should be held at the same level by both and on the same side of the body.

Avoid strain by storing heavy objects at least 12 inches above the floor.

Avoid awkward positions or twisting movements while lifting.

Over-reaching and stretching to reach overhead objects may result in strains or falls. Use a ladder instead of chairs, boxes, etc.

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ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT I

SUPPLEMENT #4 — SAMPLE SAFETY FORMS

Safety Agreement

Subcommittee: ______________________________

Instructor: ______________________________

Re: Code of Safe Practices

This will acknowledge my receipt of

1. A printed copy of the "Code of Safe Practices" and
2. A printed copy of the "Code of Safe Practices and Operations."

In consideration of my acceptance into the Apprenticeship and Training Program, I acknowledge that I have read the foregoing documents and know and understand the contents thereof and, further, that I have had an opportunity to discuss same with my instructor prior to the execution of this document.

Signed at ____________________, ____________________
(CITY) (STATE)

this ____________________ of ________________, 198______.
(DAY) (MONTH)

____
(SIGNATURE)

____
(NAME — Please print)

"Safety Agreement," "Code of Safe Practices," and "Code of Safe Practices and Operations" adapted with permission of the Northern California Joint Apprenticeship and Training Committee, Pleasanton, California.

SUPPLEMENT #4

Code of Safe Practices

Accident prevention — All persons must abide by OSHA safety standards, general industry safety orders, and company rules. Posters and other safety materials are displayed for the benefit of the employee; read and abide by these suggestions. Give every possible aid in the event of injury.

Job site — Keep work areas free of debris. Good housekeeping is essential. Remove or correct any hazards. Never work or pass under suspended load or equipment.

Work habits — Assist other trades when necessary to maintain safe operations. Never place yourself in a dangerous position or allow others to work in a dangerous position. Use the right tool or equipment for all work. Never use any alcoholic beverage on the job. Do not be a party to horseplay; pranks can be fatal. Construction sites offer unusual hazards; walk and work with all due respect for those hazards.

Hand tools — Always use the proper tools and maintain them in good condition. Never use tools with loose or broken handles, mushroom heads, or dull blades. Always use the correct size or type of tool for the job.

Power tools — Never use a powder-activated tool unless you have been licensed. Know the proper method of using a skill saw; never block back the retractable guard; it is for your protection. Never use a tool with which you are not fully experienced.

Materials-handling — Lift with the leg muscles; do not bend over and lift with your back. Learn and practice the proper way to lift or carry material or any object. Do not operate any type of powered materials-handling or hoisting equipment unless authorized. Get help in handling heavy or bulky loads.

Protective devices — Handrails, guardrails, protective covers, toeboards, ramps, and safety devices installed on various tools are there for your safety; do not tamper with, remove, or damage these protective devices. Replace, correct, or report any unsafe guard or device.

Electrical — Respect electricity under all circumstances. Never use electrical equipment in areas of excessive moisture unless you have taken all safeguards. Approved electric power tools and extensions are grounded; never alter cords or plugs.

Underground — Never enter any underground vault, manhole, silo, or any enclosed area until you are certain that the air within contains no flammable, contaminated, or toxic vapor or gas. Thoroughly test, ventilate, or wear adequate protective gear before entering enclosed areas.

Transportation — When transportation is necessary in other than a passenger vehicle, ride or sit in the cab; do not stand on the bed of a truck; never ride with arms or legs over the sides. Do not sit on the tailgate; it must be closed during transportation of passengers. Be careful of any tools, materials, or equipment within the truck body that may shift or slide and cause injury.

Flammables, solvents — Never use gasoline or other highly volatile liquids for cleaning purposes. Oxygen and acetylene cylinders can be dangerous; secure them against rolling or tipping. Handle carefully any tanks or containers that contain explosive vapor or liquid, and never expose these containers to open flame or spark.

SUPPLEMENT #4

Personal protection — Stay clear of heavy earth-moving equipment. Remain aware of warning devices such as bells, horns, or whistles. Hard hats are mandatory; always wear one on any construction job. Use other protective gear as recommended when exposed to unusual hazards. Never attempt an operation with which you are not familiar; ask first for specific instructions. Wear suitable work clothes at all times. Wear heavy-soled shoes; they protect you against a puncture injury.

First aid — Basic first aid is of value in the event of injury. Know how to give first aid; it may save a fellow worker from death. Unless you completely understand the proper method, never attempt to move a person who is possibly suffering from an injured spine or other internal injury.

Safety meetings — Tool-box meetings are held for a purpose. Attend willingly and participate by offering ideas to develop accident-free job sites. Accept advice offered by others who may be more experienced.

Accident reporting — Immediately report all personal injuries. Obtain authorization for any medical attention off the job. Medical release is necessary before returning to work.

SUPPLEMENT #4

Code of Safe Practices and Operations

General safety

1. Be alert for unsafe work methods or unsafe conditions, and either correct them or report them to your supervisor immediately.
2. Immediately report every injury—whether serious or not—to your boss.
3. Do not drink alcohol or take narcotics or habit-forming drugs in any form just before or during work hours.
4. Do not participate in horseplay, practical jokes, or sparring; they cause accidents.
5. A good night's sleep and good food make you feel better and help you avoid accidents. Get your share of sleep and good food.

Do's and don'ts

1. Do not work without a hard hat.
2. Do not work without proper eye protection.
3. Do not work without an approved protective respirator.
4. Do not work without proper footwear.
5. Do not work without proper protective clothing.
6. Do bend all exposed nails and staples.
7. Do keep work area clean and free of debris, and secure all air, water, and electric lines so that they do not become tripping hazards.
8. Do not use electrical equipment in a wet or damp area.
9. Do not leave electrical wires or equipment in water.
10. When filing trowels, do lay file on a flat surface; and while holding the trowel by the handle, stroke the trowel edge on the file.
11. Do not use wet extension handles around electrical equipment or power lines.
12. Do not use metal extension handles; they are illegal. This applies to metal extensions affixed to bull floats or fresnos.
13. Do use safety belts where necessary, and be sure safety belts are tied off at an area free of the work platform.
14. Do not overreach when working from a ladder.

SUPPLEMENT #4

15. Do wash your hands before eating or drinking.

16. Do not drink water from a concrete truck.

17. Do not contaminate water cans.

18. Do make sure all accidents and injuries are reported immediately to your supervisor.

19. Do not enter an unsafe work area. Report any unsafe area to your supervisor.

20. Do remember that you can be taken off the job for violating safety rules, for working under unsafe conditions, or for causing an unsafe condition.

21. Do not bypass any safeguards.

22. Do report any unsafe condition to your supervisor.

23. When working around epoxy-based material, do wear protective clothing and a properly filtered respirator.

24. Do not work in a confined area where gasoline-driven equipment is running unless proper ventilation is supplied.

25. When working in an excavation, do be alert for sliding soil and falling rocks, and be certain that trenching and excavating are properly shored.

26. *At all times*, do be alert for any equipment moving near you.

27. Do *be doubly alert* and thoroughly examine all shoring after a rainfall.

28. Tailgate safety meetings are for your protection and education; do be sure you attend and pay attention.

Slips and falls

More people are injured in slips and falls than in any other type of accident. Follow these safe practices to prevent slips and falls.

1. Wear safe, strong shoes that are in good repair.

2. Watch where you step. Be sure your footing is secure.

3. Do not allow yourself to get in an awkward position. Stay in control of your movements at all times.

4. Maintain clean, smooth walking and working surfaces. Fill holes, ruts, and cracks; clean up slippery material.

SUPPLEMENT #4

5. Pick up litter. Do not allow tripping hazards to exist.

6. Install cables, extension cords, and hoses so that they will not become tripping hazards.

7. If you must climb to reach something, use a sound ladder that has been safely set in position and properly secured at both top and bottom. Use only Type I industrial ladders.

8. When climbing a ladder, always face the ladder and use both hands.

9. When reaching from a ladder, keep your shoulder inside the vertical stringer. Do not overreach; move the ladder.

10. Walk, don't run.

11. Construct and use only safe scaffolds. If a scaffold is wobbly or bouncy, or can be pulled down easily, it is not safe. A scaffold should have a sound structure and have toeboards and handrails. A scaffold's wooden floor planks must be free of knots, and broken members must be repaired immediately.

12. Scaffolding must have component parts consisting of toprails that are 42 inches above platform and a midrail and a toeboard that are a minimum of 4 inches high and located no higher than ¼ inch above the platform. Platforms must be planked solid. Your supervisor will give you further specifications for properly erecting and using scaffolding.

Materials-handling

Every construction worker handles materials. It is easier and faster to handle materials the safe way. The following practices will help you move materials safely.

1. Do not move an object twice if once will do. Plan your work.

2. Do not try to lift objects that may be beyond your physical capacity and training. Get help, or use a machine or hand truck.

3. Use gloves, aprons, or pads when handling materials that are rough, sharp, hot or cold, or covered with hazardous substances.

4. While moving a load, be sure you can see where you are going.

5. When carrying long objects such as pipe or lumber, keep the leading end of the object above your head height and the trailing end close to the ground.

6. When lifting heavy objects from the floor, kneel on one knee, roll or tip the object onto the other knee, then pull the load next to your stomach and stand up. Use the reverse procedure to put down a load. Remember: Your back is not made of steel.

7. Pile material on a strong, level base. Interlock material so the pile will not come apart. Chock around stock so it cannot roll.

SUPPLEMENT #4

Hand tools

Good workers can be recognized by the tools they keep.

1. Dress cutting tools at the proper angle and keep them sharp. Keep cutting tools in a scabbard—not in your pocket. Store cutting tools in a safe place.
2. Dress the heads of most striking tools so they are square and without burrs.
3. Use the right kind of tool. Use the right size tool. Remember: A screwdriver is not a punch or chisel, a file is not a pry bar, a wrench is not a hammer, and a Stilson wrench is not a crescent wrench.
4. Hold screwdrivers, wrenches, chisels, etc., in such a way that you will not be hurt if there is a slip or a miss.
5. Do not use a file unless it has a handle.
6. Remember: If you use the proper tool for the job, the job will not require as much muscle power.

Portable power tools

1. Electrically ground every electric power tool before you use it.
2. Check the insulation on cords and the condition of plugs and sockets every day. If cords, plugs, or sockets are frayed, worn, cut, or broken, repair them before using.
3. String temporary extension cords and power lines so they will not create a tripping hazard and so they are protected from physical damage.
4. Do not use a skill saw unless the guard is in safe working condition.
5. Before using a drill on a wall, floor, or ceiling, be sure electric wires, gas lines, and high-pressure lines are not in the way.
6. Do not use cartridge tools for driving nails or spikes in walls, ceilings, or floors when people are working on the other side.

Power machinery

Remember: An unguarded hazardous piece of machinery will eventually injure someone.

1. Use machinery only when you have been authorized to do so and when you have received safety instructions.
2. Do not operate any machine unless its guards are in place.
3. If you see an unguarded machine, report it at once.

SUPPLEMENT #4

4. Be sure guards are safe. A *safe* guard covers all moving parts and is designed to permit safe oiling and adjustment.

5. If you must remove a guard, stop the machine, lock the switch, and tag the machine so another worker cannot start it.

6. Do not bypass two-handed controls or otherwise make them ineffective.

7. Loose clothing is easily caught in machinery. Loose sleeves, ties, and aprons are taboo on the job. Wrist watches, rings, and other jewelry are also taboo.

8. Use goggles, gloves, or any other protective equipment required by the job.

Chemicals

1. Know the hazardous properties of the chemicals you work with.

2. Read labels on containers and follow the manufacturer's instructions to the letter.

3. Know the first-aid treatment for any chemical you work with, and be prepared to carry out that treatment immediately if need be.

4. Store chemicals in a safe manner and according to the manufacturer's recommendations.

5. Keep chemical containers closed when not in use.

6. At regular intervals, inspect containers and pipelines that hold corrosive materials. Report leaks immediately.

7. When using corrosive materials, know where the closest shower and eye fountain are located. Keep the shower and eye fountain unobstructed and in good working condition at all times.

8. Use gas mask, goggles, gloves, and protective equipment as required.

SUPPLEMENT #4

Safety Pledge

It is understood that each student/employee will be given instruction in the use of the equipment and in the correct safety procedures concerning the equipment before she or he will be allowed to operate it. The student/employee must assume responsibility for following safe practices. We, therefore, ask that the student/employee subscribe to the following safety pledge.

I will follow all safety rules.

I will never use a machine without first having permission from my instructor or supervisor.

I will not ask permission to use a particular machine unless I have been instructed in its use and have scored 100 percent on the safety test for that machine.

I will report immediately any accident or injury, no matter how minor, to my instructor or supervisor.

Student's/employee's signature ______________________________ Date __________

Manager's signature ______________________________ Date __________

Supervisor's or instructor's signature ______________________________ Date __________

Parent's or guardian's signature ______________________________ Date __________

(Parental consent is necessary if the student/employee is under 18.)

ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT I

INFORMATION SHEET

I. Terms and definitions associated with safety

   A. **Safety** — Freedom from danger, risk, or injury

   B. **OSHA** — Occupational Safety and Health Act; federal legislation designed to ensure safe and sanitary working conditions for employees

   C. **NIOSH** — National Institute for Occupational Safety and Health

   D. **MSHA** — Mine Safety and Health Administration

   E. **Accident** — Any suddenly occurring, unintentional event that causes injury or property damage

   F. **Hazard** — Source of danger

   G. **Carelessness** — Failure to think before one acts; failure to pay attention

   H. **Flammable** — Capable of being easily ignited; burning with extreme rapidity

   I. **Explosive** — Tending to blow up or burst violently and loudly

   J. **Combustible** — Capable of bursting into flames

   K. **Extinguish** — To put out a fire; to cause to cease burning

   L. **Pressurized** — Stored under pressure greater than the pressure of the atmosphere

II. Reasons why you must be safety conscious on the job

   A. You have a responsibility to yourself to think before you act and to stay alert and aware of where you are in order to prevent personal injury

   B. You have a responsibility to your family members to continue providing for them and to keep them safe

   C. You have a responsibility to your fellow workers to prevent accidents to them by being concerned with their safety and welfare and by encouraging them to be safety conscious

   D. You have a responsibility to your employers to prevent accidents so that they are not shorthanded, their job progress is not slowed down or stopped, and their insurance rates are not increased, making them less competitive

INFORMATION SHEET

III. Consequences of a worker's using alcohol or drugs on the job

  A. Causes worker to be tardy or absent

  B. Causes worker to neglect duty and be less productive

  C. May cause worker to lose job

  D. Creates a safety hazard to worker and to fellow workers

  E. Drives up cost of production and cost of insurance, making employer less competitive

IV. Job-safety rules

  A. **General safety**

    1. Be familiar with location of fire-fighting and first-aid equipment

    2. Be alert and conduct yourself in a manner that will ensure safe practices

    3. Be conscious of others' safety and encourage others to do the same

    4. Report all accidents, regardless of nature or severity, to the supervisor

    5. Be aware of OSHA, NIOSH, MSHA, and job-project safety rules

    6. Be certain ample ventilation is provided in areas where carbon monoxide may be present

  B. **Personal safety**

    1. Remove rings and other jewelry when working

    2. Confine long hair before operating power equipment

    3. Wear close-fitting clothing appropriate for activity being performed

    4. Wear safety shoes, proper boots, and gloves

    (NOTE: All protective and safety equipment must be OSHA-approved.)

    5. Wear face and eye protection as required

    EXAMPLES: Safety glasses, goggles, face shields

    6. Wear ear protection as required

    EXAMPLES: Earplugs, earmuffs

INFORMATION SHEET

7. Wear respiratory protection approved for the contaminant you will be exposed to

   EXAMPLE: Dust respirator

   (NOTE: On jobs where it will be necessary for workers to wear respirators, respirator cleaning and storage facilities must be provided, medical examinations must be given to workers using the respirators, and a formal program should be established to train workers in selecting the correct respirator, in making sure that the respirator fits properly, and in proper procedures for using and maintaining the respirator.)

8. Protect exposed skin

   EXAMPLES: Use skin cream, body lotion, or petroleum jelly.

9. *Never* use compressed air to clean clothes or person

10. *Do not* carry sharp tools in your pockets

11. Encourage and enforce personal hygiene

    EXAMPLES: Bathe and change your clothes on a regular basis; change your gloves often (especially if they are wet); change your shoes if they get wet; clean the band inside your hard hat; remove clothing as soon as possible if it is soaked with gasoline or solvents.

C. **Equipment and tool safety**

1. Obey all safety rules, and observe limitations on equipment according to specifications and manufacturer's requirements

2. Maintain all tools in a safe working order, and properly store tools when not in use

3. Retain guards and safety devices on all equipment

4. Tag and report to the supervisor any defective tools, machines, or other equipment

5. Be sure to shut off all power equipment when finished with it, and *do not* leave equipment until it has stopped completely

6. Operate equipment only after receiving instructions on how to operate it safely

7. Disconnect power from equipment before changing accessories and before performing service or maintenance on it

8. Use the correct tool for the job for which it was intended

INFORMATION SHEET

9. Clean chips from grinders and other equipment with a brush; *do not* clean equipment with your hands or with a rag; *do not* clean equipment while it is running

D. **Work-area safety**

1. Arrange equipment to permit safe, efficient work practices and ease of cleaning
2. Store materials and supplies safely in their proper places
3. Store tools and accessories safely in cabinets, on racks, or in suitable storage areas
4. Keep work area clear of debris and other hazards
5. Always remove nails from wood prior to storage or disposal
6. Clean floors of obstructions and slippery substances; clean up spills immediately
7. Keep aisles, exits, and traffic areas free of materials and debris
8. Dispose of combustible materials properly
9. Keep sufficient brooms, brushes, waste containers, and other housekeeping equipment readily available

E. **Flammable-liquid safety**

1. Carefully read labels on all flammable liquids, and use flammable liquids only in open, well-ventilated areas

   (NOTE: Be cautious to prevent inhaling or igniting fumes from flammable liquids.)

2. Be sure that all flammable liquids are marked correctly for storage
3. Store all flammable liquids properly and only in approved safety containers

   (NOTE: Oily rags and flammable materials should be stored in metal containers with self-sealing lids.)

4. When clothing is soaked by a flammable liquid, immediately change clothing and cleanse body with appropriate cleaner
5. Use flammable liquids only for their intended purposes

   EXAMPLE: *Never* use gasoline as a cleaner.

INFORMATION SHEET

6. *Do not* use flammable liquids near fire or flame

7. Always be aware of location of appropriate fire extinguisher

8. Stop, drop, and roll to smother fire; *never* run

F. **Gasoline-powered-equipment safety**

1. Use caution to prevent contact with hot manifolds and hoses

2. Be sure that equipment is out of gear before starting

3. Always keep appropriate fire extinguisher near when starting and operating gasoline-powered equipment

4. *Do not* pour gasoline into carburetor or cylinder head when starting engine; use recommended starting fluid

5. *Never* pour gasoline into fuel tank when engine is hot or when engine is running

6. *Do not* operate equipment that is leaking gasoline

7. Stop, drop, and roll to smother fire; *never* run

G. **Materials-handling safety** (cement, concrete, organic solvents)

1. Avoid contact with the skin

2. Protect skin that is exposed

   EXAMPLES: Use protective skin cream, body lotion, or mild ointments.

3. Wear protective clothing

   EXAMPLES: Wear close-fitting clothing with snug wristbands, ankle bands, and neckband.

4. Wear properly maintained, OSHA-approved safety equipment

   EXAMPLES: Respirator, goggles, face shield, hard hat, safety belt, safety harness

5. Use good work practices to reduce dust in the air when handling cement and concrete

   EXAMPLES: *Do not* shake out cement bags unnecessarily; stand upwind when dumping cement bags; wet concrete before cutting or grinding; *do not* use compressed air to blow cement dust off clothing or work surface.

INFORMATION SHEET

6. Be certain adequate ventilation is provided when using epoxy resins, organic solvents, and other toxic substances

7. *Never* use solvents to clean skin

8. Immediately remove epoxy, organic solvents, and other substances from skin; use appropriate cleansing agents to remove these substances

V. Colors and applications of the safety color code

A. Federal safety red

1. Designates danger

2. Identifies fire-protection equipment and its location

3. Identifies portable containers of flammable liquids

4. Identifies emergency stop bars, stop buttons, and emergency electrical stop switches on machinery

B. Federal safety yellow

1. Designates caution and marks physical hazards

EXAMPLES: Low beams, protruding extensions, steps

2. Designates waste containers for explosive or combustible materials

3. Designates caution against starting, using, or moving equipment while it is under repair, and against the use of defective equipment

4. Identifies the starting point or power source of machinery

C. Federal safety orange

1. Designates dangerous parts of equipment that may cut, crush, shock, or otherwise injure

2. Designates safety starter buttons and parts of equipment that may cause electrical shock

3. Designates exposed parts (edges only) of pulleys, gears, rollers, cutting devices, and power saws

D. Federal safety purple (or black or magenta on safety yellow) — Designates radiation hazards

E. Federal safety blue

1. Designates caution against and provides information about machines or equipment out of order or under repair

INFORMATION SHEET

2. Identifies out-of-order signs on equipment

F. Federal safety green

1. Designates location of safety equipment other than fire-fighting equipment

2. Designates location of first-aid equipment

G. Federal safety black and white (used individually or in combination)

1. Designates traffic flow

2. Designates items for housekeeping purposes

3. Designates storage areas

VI. Terms and definitions associated with first aid

A. **First aid** — Immediate, temporary care given to the victim of an accident or sudden illness until the services of a physician can be obtained

B. **Resuscitation** — Act of reviving a person by bringing the person back to full consciousness

C. **Traumatic shock** — Depressed condition of many of the body functions due to failure of enough blood to circulate through the body

D. **Tourniquet** — Any device, such as a bandage and stick, used to compress a blood vessel to stop bleeding or to control blood flow

(NOTE: Tourniquets are used only on severe, life-threatening hemorrhage that cannot be controlled by any other means.)

E. **Hemorrhage** — Heavy loss of blood

F. **Closed fracture** — Broken bone beneath the skin with no open wound

G. **Open fracture** — Broken bone associated with an open wound

EXAMPLES: A broken bone tears through the skin; machinery penetrates the skin and breaks one or more bones.

VII. Reasons why knowledge of first aid is important

A. May mean the difference between life and death

B. May mean the difference between temporary and permanent disability

C. May mean the difference between rapid recovery and long hospitalization

D. Prepares one for what to do and what *not* to do in an emergency

INFORMATION SHEET

E. Promotes safety awareness

VIII. First-aid actions to follow in an emergency

(NOTE: When you give first aid, you must first deal with the victim's physical condition, the victim's emotional state, and the whole accident situation. However, first aid may also include care needed later if medical help is delayed or is not available. Urgent care is first aid given in a life-threatening situation. These situations include stopped breathing, heart attack, stroke, heavy bleeding, poisoning, and shock. The actions listed below are from the Red Cross book *Standard First Aid and Personal Safety* and are given in the order you might follow in an emergency.)

A. Rescue victim and yourself

B. Restore or maintain breathing and heartbeat

C. Control heavy bleeding

D. Treat for poisoning

E. Prevent traumatic shock

F. Examine victim carefully

G. Seek medical help

H. Keep checking and assisting victim until medical help is obtained

ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT I

ASSIGNMENT SHEET #1 — VISIT A JOB SITE AND COMPLETE A SAFETY CHECKLIST

NAME ______________________________ SCORE ______________

One of the first steps to becoming safety conscious is being able to recognize safe on-the-job practices. Completing this assignment sheet will help you become more familiar with some of these practices.

Obtain permission to observe a job site for a few hours, and then fill out the checklist below. Write an "X" in the blank before any checklist item that is *not* being observed on the job site.

______A. Are adequate training and supervision visible?

______B. Are emergency telephone numbers posted?

______C. Are safety bulletins, posters, and charts displayed?

______D. Is knowledge of safety and first aid visible?

______E. Are inspection and accident reporting forms available?

______F. Is there any evidence of horseplay or scuffling that may tend to create a hazard?

______G. Is there any evidence of overloading ladders, scaffolds, or elevators?

______H. Is there indication of workers' using intoxicating liquors or drugs?

______I. Does all equipment have safety devices and grounds?

______J. Is the safety dress code being observed by all workers?

______K. Is an adequate work area provided?

______L. Are adequate walkways and runways provided?

______M. Are adequate stairways or elevators provided?

______N. Are ladders and scaffolds used safely?

______O. Are work areas and passageways clear of rubbish, debris, nails, etc.?

______P. Is there adequate illumination?

______Q. Is protection provided for floor and roof openings?

______R. Is protection provided for trenches and other excavations?

ASSIGNMENT SHEET #1

______S. Is there an adequate parking area?

______T. Is there adequate turnaround space?

______U. Are parking areas and drives free from excessive mud and trash?

______V. Is there separate storage for materials?

______W. Are there separate dump areas?

______X. Are toolsheds, office, and other structures safely and conveniently located?

______Y. Are power sources, high-voltage lines, and other electrical equipment located for safety and convenience?

______Z. Are sanitary facilities, first-aid stations, and drinking water located for safety and convenience?

____AA. Are safety materials and equipment on the job in good condition, and are they convenient when needed?

____BB. Is there proper auxiliary equipment for handling materials available on the job site?

____CC. Is there adequate space for maneuvering vehicles for elevating and handling materials?

____DD. Is there adequate space for loading and unloading equipment and materials?

____EE. Is there an adequate supply of the right tools for each part of the job?

____FF. Is there an adequate number of workers for jobs being performed?

____GG. On the blanks below, add any other safety violations or hazardous condition you may have observed.

____

____

____

____

____

____

____

ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT I

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1 — Evaluated to the satisfaction of the instructor

ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT I

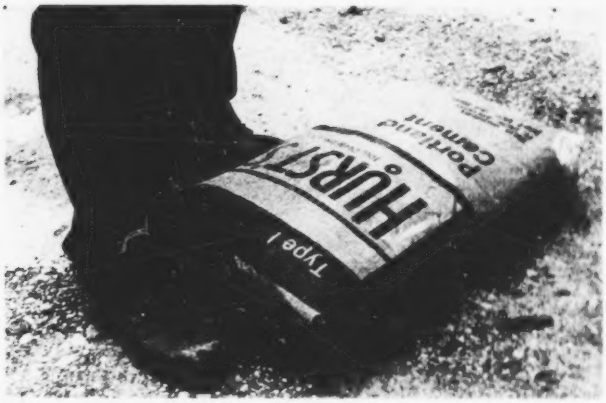
JOB SHEET #1 — LIFT A HEAVY OBJECT PROPERLY

I. Equipment — Heavy object

II. Procedure

A. Step up to object; place one foot beside object and one behind (Figure 1)

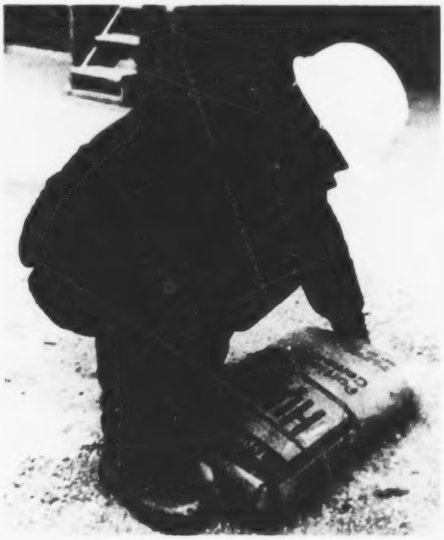
FIGURE 1



B. Bend the knees and get a good handhold on the object (See Figure 2)

C. Tuck in chin (Figure 2)

FIGURE 2

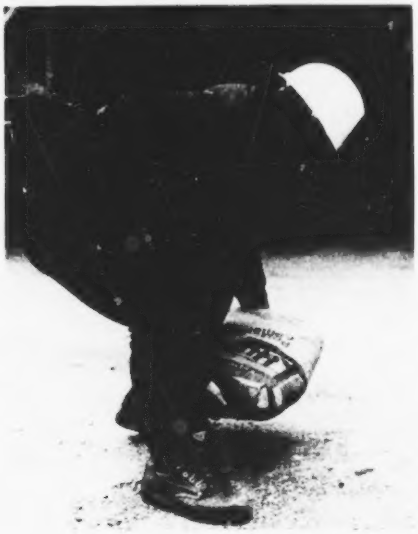


JOB SHEET #1

D. Tuck in elbows and arms (See Figure 3)

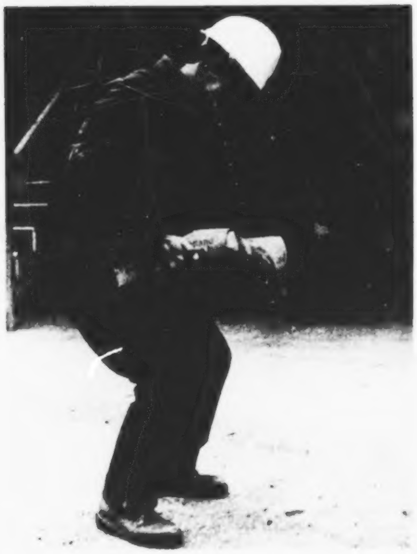
E. Hold load close to body (Figure 3)

FIGURE 3



F. Keeping back straight and body weight directly over feet, push with your legs as you stand straight up (Figure 4)

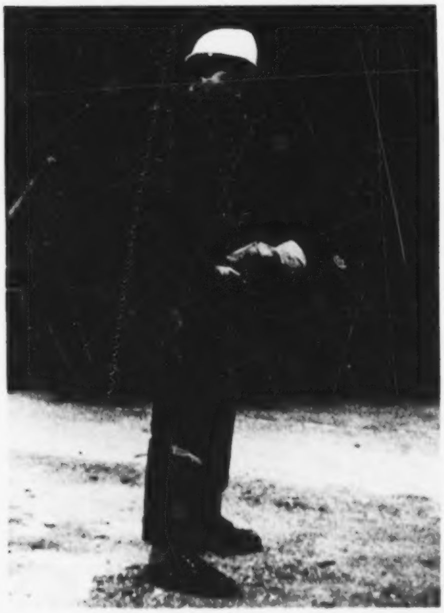
FIGURE 4



JOB SHEET #1

G. Lift the object into carrying position, making no turning or twisting movements until lift is completed (Figure 5)

FIGURE 5



ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT I

TEST

NAME ______________________________ SCORE ______________

1. Match terms and definitions associated with safety. For each of the following definitions, select the term listed with that definition in the information sheet, and then write the correct number in the blank.

______a. Tending to blow up or burst violently and loudly
1. Danger
2. Explosive
3. Harm

______b. Any suddenly occurring, unintentional event that causes injury or property damage
1. Mishap
2. Accident
3. Hazard

______c. Federal legislation designed to ensure safe and sanitary working conditions for employees
1. MSHA
2. NIOSH
3. OSHA

______d. To put out a fire; to cause to cease burning
1. Extinguish
2. Strangle
3. Inflame

______e. Freedom from danger, risk, or injury
1. Reprieve
2. Contentment
3. Safety

______f. Source of danger
1. Accident
2. Hazard
3. Mishap

______g. Stored under pressure greater than the pressure of the atmosphere
1. Pressurized
2. Explosive
3. Combustible

______h. National Institute for Occupational Safety and Health
1. MSHA
2. ACI
3. NIOSH

TEST

_____i. Failure to think before one acts; failure to pay attention

1. Incompetence
2. Carelessness
3. Ignorance

_____j. Capable of bursting into flames

1. Flammable
2. Combustible
3. Explosive

_____k. Mine Safety and Health Administration

1. MSHA
2. AGC
3. ASTM

_____l. Capable of being easily ignited; burning with extreme rapidity

1. Combustible
2. Flammable
3. Explosive

2. State two reasons why you must be safety conscious on the job.

a. ______________________________

b. ______________________________

3. State three consequences of a worker's using alcohol or drugs on the job.

a. ______________________________

b. ______________________________

c. ______________________________

TEST

4. State job-safety rules for the following categories.

General safety (State three rules.)

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

Personal safety (State four rules.)

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

d. ______________________________

____

Equipment and tool safety (State three rules.)

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

TEST

Work-area safety (State three rules.)

a. ____

____

b. ____

____

c. ____

____

Flammable-liquid safety (State three rules.)

a. ____

____

b. ____

____

c. ____

____

Gasoline-powered-equipment safety (State three rules.)

a. ____

____

b. ____

____

c. ____

____

Materials-handling safety (State three rules.)

a. ____

____

b. ____

____

c. ____

____

TEST

5. Match colors of the safety color code to their correct applications. Write the correct numbers in the blanks. Answers may be used more than once.

______a. Designates radiation hazards

______b. Designates safety starter buttons and parts of equipment that may cause electrical shock

______c. Designates items for housekeeping purposes

______d. Designates location of first-aid equipment

______e. Identifies fire-protection equipment and its location

______f. Designates waste containers for explosive or combustible materials

______g. Designates caution against and provides information about machines or equipment out of order or under repair

______h. Designates danger

______i. Designates traffic flow

______j. Identifies the starting point or power source of machinery

______k. Identifies portable containers of flammable liquids

______l. Identifies out-of-order signs on equipment

______m. Designates caution against starting, using, or moving equipment while it is under repair, and against the use of defective equipment

______n. Designates exposed parts (edges only) of pulleys, gears, rollers, cutting devices, and power saws

______o. Identifies emergency stop bars, stop buttons, and emergency electrical stop switches on machinery

______p. Designates storage areas

______q. Designates caution and marks physical hazards

______r. Designates location of safety equipment other than fire-fighting equipment

______s. Designates dangerous parts of equipment that may cut, crush, shock, or otherwise injure

1. Federal safety red
2. Federal safety yellow
3. Federal safety orange
4. Federal safety purple (or black or magenta on safety yellow)
5. Federal safety blue
6. Federal safety green
7. Federal safety black and white (used individually or in combination)

TEST

6. Select correct definitions of terms associated with first aid. Write an "X" in the blank before the best definition.

   a. A *closed fracture* is a

   ______1. Compound fracture

   ______2. Broken bone beneath the skin with no open wound

   ______3. Broken bone that has been immobilized

   b. *Resuscitation* is the

   ______1. Act of reviving a person by giving the person hot, black coffee and forcing him or her to walk

   ______2. Act of reviving a person by applying pressure directly to a wound

   ______3. Act of reviving a person by bringing the person back to full consciousness

   c. *Traumatic shock* is a

   ______1. Depressed condition of many of the body functions due to failure of enough blood to circulate through the body

   ______2. Condition existing when skin is flushed, hot, and dry and body temperature is high

   ______3. Condition existing when skin surface is hard but underlying tissue is soft

   d. A *hemorrhage* is a

   ______1. Flow of blood; mass of dilated veins in swollen tissue situated near the anal sphincter

   ______2. Heavy loss of blood

   ______3. Protrusion of an organ through connective tissue or through a wall of the cavity in which it is normally enclosed

   e. *First aid* is the

   ______1. Rhythmic forcing of air into and out of the lungs of a person who has been injured

   ______2. Act of reviving an accident victim by bringing him or her back to full consciousness

   ______3. Immediate, temporary care given to the victim of an accident or sudden illness until the services of a physician can be obtained

TEST

f. An *open fracture* is a

______1. Simple uncovered fracture

______2. Broken bone that must be splinted and put in a sling

______3. Broken bone associated with an open wound

g. A *tourniquet* is

______1. Any device, such as a bandage and stick, used to compress a blood vessel to stop bleeding or to control blood flow

______2. Any clean bandanna compressed directly against the wound to control bleeding

______3. A triangular bandage made into a sling to hold the affected part until victim can get to hospital

7. State two reasons why knowledge of first aid is important.

a. ____

____

b. ____

____

8. Arrange in order first-aid actions to follow in an emergency. Write a "1" in the blank before the first step, a "2" in the blank before the second step, and so on.

______a. Control heavy bleeding

______b. Restore or maintain breathing and heartbeat

______c. Rescue victim and yourself

______d. Examine victim carefully

______e. Treat for poisoning

______f. Prevent traumatic shock

______g. Keep checking and assisting victim until medical help is obtained

______h. Seek medical help

(NOTE: Test item 9 lists the job sheet. It is an important part of this test. If it has not been completed, check with your instructor.

9. Demonstrate the ability to properly lift a heavy object.

ORIENTATION TO SAFETY AND BASIC FIRST AID
UNIT I

ANSWERS TO TEST

1. a. 2
   b. 2
   c. 3
   d. 1
   e. 3
   f. 2
   g. 1
   h. 3
   i. 2
   j. 2
   k. 1
   l. 2

2. Answer should include any two of the following

   a. You have a responsibility to yourself to think before you act and to stay alert and aware of where you are in order to prevent personal injury
   b. You have a responsibility to your family members to continue providing for them and to keep them safe
   c. You have a responsibility to your fellow workers to prevent accidents to them by being concerned with their safety and welfare and by encouraging them to be safety conscious
   d. You have a responsibility to your employers to prevent accidents so that they are not shorthanded, their job progress is not slowed down or stopped, and their insurance rates are not increased, making them less competitive

3. Answer should include any three of the following

   a. Causes worker to be tardy or absent
   b. Causes worker to neglect duty and be less productive
   c. May cause worker to lose job
   d. Creates a safety hazard to worker and to fellow workers
   e. Drives up cost of production and cost of insurance, making employer less competitive

4. **General safety** (Answer should include any three of the following)

   a. Be familiar with location of fire-fighting and first-aid equipment
   b. Be alert and conduct yourself in a manner that will ensure safe practices
   c. Be conscious of others' safety and encourage others to do the same
   d. Report all accidents, regardless of nature or severity, to the supervisor
   e. Be aware of OSHA, NIOSH, MSHA, and job-project safety rules
   f. Be certain ample ventilation is provided in areas where carbon monoxide may be present

   Personal safety (Answer should include any four of the following)

   a. Remove rings and other jewelry when working
   b. Confine long hair before operating power equipment
   c. Wear close-fitting clothing appropriate for activity being performed
   d. Wear safety shoes, proper boots, and gloves
   e. Wear face and eye protection as required
   f. Wear ear protection as required

ANSWERS TO TEST

g. Wear respiratory protection approved for the contaminant you will be exposed to
h. Protect exposed skin
i. *Never* use compressed air to clean clothes or person
j. *Do not* carry sharp tools in your pockets
k. Encourage and enforce personal hygiene

Equipment and tool safety (Answer should include any three of the following)

a. Obey all safety rules, and observe limitations on equipment according to specifications and manufacturer's requirements
b. Maintain all tools in a safe working order, and properly store tools when not in use
c. Retain guards and safety devices on all equipment
d. Tag and report to the supervisor any defective tools, machines, or other equipment
e. Be sure to shut off all power equipment when finished with it, and *do not* leave equipment until it has stopped completely
f. Operate equipment only after receiving instructions on how to operate it safely
g. Disconnect power from equipment before changing accessories and before performing service or maintenance on it
h. Use the correct tool for the job for which it was intended
i. Clean chips from grinders and other equipment with a brush; *do not* clean equipment with your hands or with a rag; *do not* clean equipment while it is running

Work-area safety (Answer should include any three of the following)

a. Arrange equipment to permit safe, efficient work practices and ease of cleaning
b. Store materials and supplies safely in their proper places
c. Store tools and accessories safely in cabinets, on racks, or in suitable storage areas
d. Keep work area clear of debris and other hazards
e. Always remove nails from wood prior to storage or disposal
f. Clean floors of obstructions and slippery substances; clean up spills immediately
g. Keep aisles, exits, and traffic areas free of materials and debris
h. Dispose of combustible materials properly
i. Keep sufficient brooms, brushes, waste containers, and other housekeeping equipment readily available

Flammable-liquid safety (Answer should include any three of the following)

a. Carefully read labels on all flammable liquids, and use flammable liquids only in open, well-ventilated areas
b. Be sure that all flammable liquids are marked correctly for storage
c. Store all flammable liquids properly and only in approved safety containers
d. When clothing is soaked by a flammable liquid, immediately change clothing and cleanse body with appropriate cleaner
e. Use flammable liquids only for their intended purposes
f. *Do not* use flammable liquids near fire or flame
g. Always be aware of location of appropriate fire extinguisher
h. Stop, drop, and roll to smother fire; *never* run

ANSWERS TO TEST

Gasoline-powered-equipment safety (Answer should include any three of the following)

a. Use caution to prevent contact with hot manifolds and hoses
b. Be sure that equipment is out of gear before starting
c. Always keep appropriate fire extinguisher near when starting and operating gasoline-powered equipment
d. *Do not* pour gasoline into carburetor or cylinder head when starting engine; use recommended starting fluid
e. *Never* pour gasoline into fuel tank when engine is hot or when engine is running
f. *Do not* operate equipment that is leaking gasoline
g. Stop, drop, and roll to smother fire; *never* run

Materials-handling safety (Answer should include any three of the following)

a. Avoid contact with the skin
b. Protect skin that is exposed
c. Wear protective clothing
d. Wear properly maintained, OSHA-approved safety equipment
e. Use good work practices to reduce dust in the air when handling cement and concrete
f. Be certain adequate ventilation is provided when using epoxy resins, organic solvents, and other toxic substances
g. *Never* use solvents to clean skin
h. Immediately remove epoxy, organic solvents, and other toxic substances from skin; use appropriate cleansing agents to remove these substances

5. a. 4
b. 3
c. 7
d. 6
e. 1
f. 2
g. 5
h. 1
i. 7
j. 2
k. 1
l. 5
m. 2
n. 3
o. 1
p. 7
q. 2
r. 6
s. 3

6. a. 2
b. 3
c. 1
d. 2
e. 3
f. 3
g. 1

7. Answer should include any two of the following

a. May mean the difference between life and death
b. May mean the difference between temporary and permanent disability
c. May mean the difference between rapid recovery and long hospitalization
d. Prepares one for what to do and what *not* to do in an emergency
e. Promotes safety awareness

8. a. 3
b. 2
c. 1
d. 6
e. 4
f. 5
g. 8
h. 7

9. Performance skills evaluated to the satisfaction of the instructor

BASIC MATH
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to solve basic math problems. The student will show this ability by completing unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with basic math.
2. Match to their correct names symbols used in math problems.
3. Label the place values of a whole number.
4. Add whole numbers.
5. Subtract whole numbers.
6. Multiply whole numbers.
7. Divide whole numbers.
8. Distinguish among types of fractions.
9. Reduce fractions to lowest terms.
10. Convert mixed numbers to improper fractions.
11. Convert improper fractions to mixed numbers.
12. Add fractions.
13. Subtract fractions.
14. Multiply fractions.
15. Divide fractions.
16. Label the place values of a decimal number.
17. Add decimal numbers.
18. Subtract decimal numbers.

OBJECTIVE SHEET

19. Multiply decimal numbers.
20. Divide decimal numbers.
21. Convert fractions to decimal numbers and percentages.
22. Identify decimal and fractional equivalents.
23. Convert percentages to fractions and decimal numbers.
24. Solve percentage problems.
25. Match terms used in geometry to their correct definitions.
26. Match types of geometric figures to their correct descriptions.
27. Match units of measure to their correct equivalents.
28. Calculate area of geometric figures.
29. Calculate volume of solid figures.
30. Solve basic ratio and proportion problems.

BASIC MATH
UNIT II

SUGGESTED ACTIVITIES

I. Unit contents

- A. Objective sheet
- B. Suggested activities
- C. Supplements
  1. Supplement #1 — Crossword Puzzle of Basic Math Terms
  2. Supplement #2 — Subtraction Squares
  3. Supplement #3 — Division Rap
  4. Supplement #4 — Geometry Terms Word Search
  5. Supplement #5 — Crossnumber Puzzle of Math Problems
- D. Answers to supplements
- E. Information sheet
- F. Assignment sheets
  1. Assignment Sheet #1 — Add Whole Numbers
  2. Assignment Sheet #2 — Subtract Whole Numbers
  3. Assignment Sheet #3 — Multiply Whole Numbers
  4. Assignment Sheet #4 — Divide Whole Numbers
  5. Assignment Sheet #5 — Work with Fractions
  6. Assignment Sheet #6 — Reduce Fractions to Lowest Terms
  7. Assignment Sheet #7 — Convert Unlike Fractions to Like Fractions
  8. Assignment Sheet #8 — Convert Fractions and Mixed Numbers
  9. Assignment Sheet #9 — Add Fractions
  10. Assignment Sheet #10 — Subtract Fractions
  11. Assignment Sheet #11 — Multiply Fractions

SUGGESTED ACTIVITIES

12. Assignment Sheet #12 — Divide Fractions
13. Assignment Sheet #13 — Add Decimal Numbers
14. Assignment Sheet #14 — Subtract Decimal Numbers
15. Assignment Sheet #15 — Multiply Decimal Numbers
16. Assignment Sheet #16 — Divide Decimal Numbers
17. Assignment Sheet #17 — Convert Fractions and Percentages
18. Assignment Sheet #18 — Solve Percentage Problems
19. Assignment Sheet #19 — Calculate Area
20. Assignment Sheet #20 — Calculate Volume
21. Assignment Sheet #21 — Estimate Cubic Yards
22. Assignment Sheet #22 — Solve Basic Ratio and Proportion Problems

G. Answers to assignment sheets

H. Test

I. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Books

a. *Speaking of Numbers.* This self-instructional workbook/textbook series is intended for use with two groups of students: (1) beginning English-as-a-second-language students who are concurrently studying English and basic mathematic skills; and (2) native speakers of English who require remediation and reinforcement in numbers and arithmetic operations.

(NOTE: *Speaking of Numbers* is available from the Institute of Modern Languages, 2622 Pittman Drive, Silver Spring, Maryland 20910.)

SUGGESTED ACTIVITIES

b. *Math*. This book is part of a series of manuals developed specifically for special-needs programs for disadvantaged and handicapped students. Seven areas of instruction have assignment sheets specifically designed to acquaint students with basic and practical mathematical problems and terms directly related to vocational skill trades. The guide contains instruction in measurement, whole numbers, fractions, decimals, percentages, consumer education, and geometry.

(NOTE: *Math* is available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364.)

2. Competency profiles

(NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006. Phone [202] 393-2040.)

C. Make additional copies of assignment sheets and supplements if needed.

D. Use the assignment sheets (or parts of them) to pretest students in each math concept. Those students who demonstrate proficiency and an understanding of the concept may use the assignment sheets as a review or may be paired with those students who need help in mastering the concepts.

E. Provide students with objective sheet.

F. Discuss unit and specific objectives.

- Introduce unit by discussing the technological explosion presently underway in the world and its effects on our lives. Emphasize the increased demand for technical skills.

- Point out that an understanding of mathematical concepts, a grasp of analytical logic, accuracy in computational skills, and the ability to apply these skills to a wide variety of situations are essential to getting and keeping a job.

G. Provide students with information and assignment sheets.

H. Discuss information and assignment sheets.

SUGGESTED ACTIVITIES

1. Use Information Sheet, Section I, to discuss terms associated with basic math.
   - Point out the importance of defining terms for common understanding.
   - Have students complete Supplement #1 as a review of terms.
2. Use Information Sheet, Section II, to discuss symbols used in math problems.
   - Prepare examples of problems using the symbols.
   - Have students discuss where they have seen the math symbols used.
3. Use Information Sheet, Sections III and IV, and Assignment Sheet #1 to discuss place values of whole numbers and addition.
   - Play "You Inherit" with the students to help them learn place values. Ask students to tell you the least amount they inherit when you give them the amount in numbers of digits.

     EXAMPLE: Q. You have just inherited a six-digit sum. What is the least amount you inherit?
     A. One hundred thousand dollars
   - Prepare groups of objects such as bottle caps, books, tacks, nails, boards, and crayons to be added at different tables. Have students stop at each table and perform the addition as directed. Provide each student with a work sheet on which the equation and answer could be written.

     (NOTE: Similar situations could be set up for subtraction.)
   - Have students play dominoes. Score ends in multiples of five and play to 250, or score ends at end of each turn and play to 1000 points.
4. Use Information Sheet, Section V, and Assignment Sheet #2 to discuss subtraction.
   - Develop a set of flash cards containing various subtraction problems. Show students each card and have them give you the correct answer, either orally or written on a sheet of paper.
   - Use spinner and game boards. Each student spins twice, writes down each number, subtracts the difference, and moves the marker the appropriate number of jumps.

SUGGESTED ACTIVITIES

- Have students practice subtraction by completing Supplement #2.

  (NOTE: You may want to prepare similar squares for addition, multiplication, and division with whole numbers, fractions, or decimals; or for calculations with exponents and square roots of the perfect square.)

5. Use Information Sheet, Section VI, and Assignment Sheet #3 to discuss multiplication.

   - Obtain or make multiplication table to 12. Have students learn the table.

   - Sit students in a circle. Have all students clap hands twice on legs, then clap hands together twice, then snap fingers twice to establish a rhythm that is to continue unbroken throughout the game. The caller gives a multiplication (or other operation) problem such as 8 × 6 while snapping fingers, and at the next finger snapping, says the name of someone to answer the problem. The responder gives answer at next finger snapping without breaking the clap/snap rhythm. If the responder maintains the rhythm and gives the correct answer, then he or she becomes the next caller. If the responder breaks the rhythm or gives an incorrect answer, then he or she is out of the game. The last person left is the winner.

6. Use Information Sheet, Section VII, and Assignment Sheet #4 to discuss division.

   - Do the Division Rap in Supplement #3. Make a transparency or handouts of the general section, which is the section that the students learn. Recite the general section, and then write the division problem on the chalkboard. Work the problem as you describe the steps in the specific section of the rap. Encourage students to chime in on each repeat of "Divide, Multiply, Subtract, and Bring Down."

   - For students who consistently cannot make the appropriate decisions to solve long-division exercises, try the decision-free, step-by-step procedure on the next page.

SUGGESTED ACTIVITIES

a. Copy the problem.

b. Draw a vertical line to the right of the problem.

c. Make a guess and write that down to the right of the vertical line.

d. Multiply the guess by the divisor and subtract from the original number.

e. Repeat the process until subtracting produces a number smaller than divisor.

52)86310	
52000	1000
34310	
20800	400
13510	
10400	200
3110	
2600	50
510	
416	8
94	
52	1
42	1659

f. The answer is the sum of the guesses.

g. Check by multiplying the answer times the divisor and adding the remainder. If the problem has been solved correctly, the resulting sum should equal the original number inside the division frame.

EXAMPLE:	1659	Answer
	× 52	Divisor
	3318	
	8295	
	86268	
	+ 42	Remainder
	86310	Sum Equal to Original Number

7. Use Information Sheet, Section VIII, and Assignment Sheet #5 to discuss types of fractions.

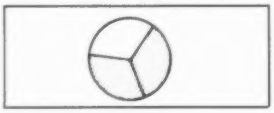
    - Write a proper fraction, such as $^{3}/_{8}$, on the chalkboard. Label the fraction's nominator and denominator. Explain that the denominator of this (or any) fraction represents the way the unit has been split. Illustrate this point by drawing on the chalkboard a circle split into eight parts. Now explain that the numerator of this (or any) fraction represents the number of parts involved in the calculation. Therefore the fraction $^{3}/_{8}$ indicates three parts of something that has been divided into eight parts. Shade in three of the eight parts of the circle to illustrate this point.

SUGGESTED ACTIVITIES

- Make two decks of cards. Show fractions on one deck and the corresponding pictures on the other deck.

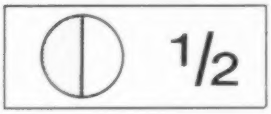
  EXAMPLE:

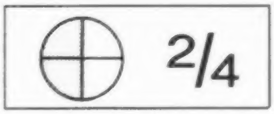
  2/3



Cards can also be made to show equivalent fractions, using pictures and fractions.

EXAMPLE:





Students may play a game of matching or rummy by making pairs that match.

8. Use Information Sheet, Section IX, and Assignment Sheets #6 and #7 to discuss reducing fractions to the lowest terms and converting unlike fractions to like fractions.

- Prepare twenty-four tagboard flash cards. On each card, write two or three unlike fractions.

  EXAMPLES:

  1/2 3/8 3/4

  3/5 2/3 1/6

  Laminate the cards. Have students number their papers from 1 to 24; then give them fifteen seconds to write the least common denominator for the fractions on each flash card shown. To increase the difficulty, shorten the time-span for calculating each lowest common denominator.

- Use these flash cards to review addition, subtraction, and multiplication of fractions.

SUGGESTED ACTIVITIES

9. Use Information Sheet, Sections X and XI, and Assignment Sheet #8 to discuss converting mixed numbers to improper fractions and converting improper fractions to mixed numbers.

   - Have students practice measuring with rulers by measuring various items in the classroom: length of books, length and width of desk or table, height of chairs, length of pencil, and so on. Have students record their measurements on a sheet of paper, and then have them convert their measurements into improper fractions. After they have the improper fractions, have them give their lists to another student who then converts the improper fractions to mixed numbers.

10. Use Information Sheet, Section XII, and Assignment Sheet #9 to discuss adding fractions.

11. Use Information Sheet, Section XIII, and Assignment Sheet #10 to discuss subtracting fractions.

12. Use Information Sheet, Section XIV, and Assignment Sheet #11 to discuss multiplying fractions.

13. Use Information Sheet, Section XV, and Assignment Sheet #12 to discuss dividing fractions.

   - Point out that dividing fractions is just like multiplying fractions—except for the inversion step.

14. Use Information Sheet, Section XVI, to discuss the place values of decimals.

   - Have students write down several decimal numbers. Have students write out the decimal number by place values, i.e., tenths, hundredths, thousandths, ten thousandths, millionths.

15. Use Information Sheet, Section XVII, and Assignment Sheet #13 to discuss adding decimal numbers.

   - Assign a monetary value to each letter of the alphabet: A = $0.50, B = $1.00, C = $1.50 . . . Z = $13.00. Then have students calculate such problems as who has the most valuable name? What hand tool has the most valuable name? What power tool has the most valuable name?

     (NOTE: This activity can be adapted and used to practice multiplication of whole numbers, or for practice with fractions.)

16. Use Information Sheet, Section XVIII, and Assignment Sheet #14 to discuss subtracting decimal numbers. Emphasize the importance of checking answers.

17. Use Information Sheet, Section XIX, and Assignment Sheet #15 to discuss multiplying decimal numbers.

SUGGESTED ACTIVITIES

- Increase student speed in certain multiplication problems by giving timed tests in which the student must use the following shortcuts.

  To multiply by

  5, 50, 500, etc., just multiply by 10, 100, 1000, etc., and divide by 2;

  25, 250, 2500, etc., just multiply by 100, 1000, etc., and divide by 4;

  $33\frac{1}{3}$, $16\frac{2}{3}$, $12\frac{1}{2}$, $8\frac{1}{3}$, $6\frac{1}{4}$ multiply by 100 and divide by 3, 6, 8, 12, 16, respectively.

18. Use Information Sheet, Section XX, and Assignment Sheet #16 to discuss dividing decimal numbers.

    - Increase student speed in certain division problems by giving timed tests in which students use the following shortcuts.

      To divide by

      $3\frac{1}{3}$, multiply by 3 and divide by 10;

      $33\frac{1}{3}$, multiply by 3 and divide by 100;

      $16\frac{2}{3}$, multiply by 6 and divide by 100;

      25, multiply by 4 and divide by 100;

      50, multiply by 2 and divide by 100.

      (NOTE: There are other shortcuts that you may want to add to this list of multiplication shortcuts.)

19. Use Information Sheet, Sections XXI through XXIV, and Assignment Sheets #17 and #18 to discuss fractional equivalents and the conversion of fractions and decimals.

    - Before presenting rules for converting fractions to decimals, have students solve problems by converting the decimals to fractions. The answer from the computation with the equivalent fractions must then be converted back to a decimal form. A half dozen exercises like this for each decimal rule may help students appreciate the benefits of learning the rules and why the decimal rules work.

SUGGESTED ACTIVITIES

EXAMPLE: $5.67 + 3.2 + 4.104 = 5\frac{670}{1000} + 3\frac{200}{1000} + 4\frac{104}{1000}$

$$= 12\frac{974}{1000}$$

$$= 12.974$$

- Obtain a set of twist drills and a drill index. Take the drills out of the drill index. Have students replace drills in the index, noting the decimal and fractional differences in the drill sizes.

- Obtain a quantity of pocket-sized decimal equivalent charts from your local tool supplier. Give one to each student.

- Illustrate percentages by providing students with graph or grid paper. Have students outline at least eight 10-by-10-block squares. Since each block contains 100 units or small squares, students can shade in enough units to illustrate 25 percent, 33⅓ percent, 50 percent, 96 percent, and so on.

- Have students complete Supplement #5, Crossnumber Puzzle of Math Problems, to practice addition, subtraction, multiplication, division, multiplying fractions, and computing percentages.

20. Use Information Sheet, Section XXV, to discuss terms used in geometry.

    - Have students review the terms by completing Supplement #4.

21. Use Information Sheet, Section XXVI, to discuss types of geometric figures.

    - Develop a bulletin board display showing types of geometric figures.

    - Prepare poster-board cutouts of each geometric figure. As you discuss each figure, attach the cutout to the chalkboard (with masking tape on back) or attach the cutout to a clothesline. When discussion is completed, students will be able to observe the differences among the types of geometric figures.

22. Use Information Sheet, Section XXVII, to discuss common units of measure and their equivalents.

    - Have students practice measuring with a tape measure. Use various lengths of lumber. Have students measure width, thickness, and length of each piece and write their answers on a sheet of paper. As additional practice, you could have students convert all fractions to decimals.

SUGGESTED ACTIVITIES

- Illustrate the length of a rod by measuring and marking a 16 1/2-foot line on your classroom floor.

23. Use Information Sheet, Section XXVIII, and Assignment Sheet #19 to discuss formulas for calculating areas of geometric figures.

    - Floor plans of buildings can be a source for a variety of mathematical problems. Sample floor plans may be obtained from blueprints of homes, newspapers, or perhaps from old real-estate-agency listings. Some students may prefer to design their own floor plans. Provide students with a floor plan and have them calculate the total square feet in the building and the square feet for each room.

24. Use Information Sheet, Section XXIX, and Assignment Sheets #20 and #21 to discuss calculating the volume of solid figures.

    - Visit a construction site before concrete is to be poured. Have students measure forms and determine the volume of concrete that will be needed. You may want to have the students determine the total cost of the concrete, also.

25. Use Information Sheet, Section XXX, and Assignment Sheet #22 to discuss ratio and proportion.

I. Give test.

(NOTE: You may want to give this test in parts, such as the math processes, fractions, and decimals.)

J. Critique test and discuss in class.

K. Reteach if necessary.

L. Complete appropriate section of competency profiles.

III. Unit reference

Hendrix, Laborn J. "Bud." *Fundamentals of Concrete and Cement Masonry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1987.

BASIC MATH
UNIT II

SUPPLEMENT #1 — CROSSWORD PUZZLE OF BASIC MATH TERMS

NAME ______________________________ SCORE ______________

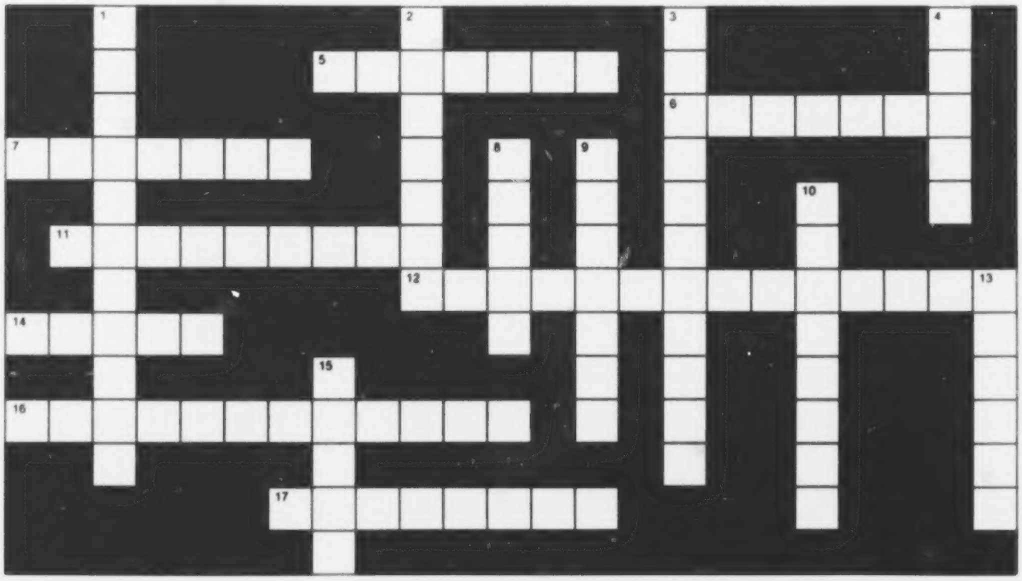
To help you review the terms used in this unit, use the clues below to complete the following crossword puzzle.

ACROSS

5. One part in a hundred; reckoned on the basis of a whole divided into one hundred parts
6. Pertaining to nominal units based on a 4-inch module
7. Any of the natural numbers; the whole numbers, positive and negative
11. To solve by mathematical process
12. Abbreviated process of adding a number to itself a specified number of times
14. Relationship in quantity, amount, or size between two or more things
16. Being relatively equal in size or quantity
17. Opposite (inverse) operation of multiplication

DOWN

1. Opposite (inverse) operation of addition
2. Mathematical proposition
3. Theoretical size that may vary from the actual (2 wds.)
4. Inverted "V" symbol used to indicate where something is to be inserted
8. With 13 Down, any of the integers that represents a complete item
9. Fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the numerator
10. Part of a whole; represents one or more equal parts of a unit
13. See 8 Down
15. Any one of the ten symbols, 0 to 9, by which all numbers can be expressed



BASIC MATH
UNIT II

SUPPLEMENT #2 — SUBTRACTION SQUARES

Cut out the sixteen squares shown below, and then fit them together so that the edges that touch form a problem and its correct solution. For better durability, glue the sheet to heavy poster board before cutting out squares.

10−5 6 9−1 8−1	8 10−7 15−5 12−2	9−4 5	11−2 2
6 6−2 12−6 10−2	7 10 6−4 9−6	4−0 7	0 12−3
7−4 2 4	3 10−6 9−2	10 8−3 4	4 3 5
9 8 3	1 8−8 5	9 7−6 9−3	8−6 4 7−3

BASIC MATH
UNIT II

SUPPLEMENT #3 — DIVISION RAP

DIVISION RAP

General Section:

I'm Dr. P. and I'm on the scene
With my division rap and it's truly mean
It goes "Divide, Multiply, Subtract, and Bring Down."
I said, "Divide, Multiply, Subtract, and Bring Down."

Now we can do it wrong, or we can do it right.
But if we do it wrong, we'll be here all night.
So let's Divide, Multiply, Subtract, and Bring Down
Again, Divide, Multiply, Subtract, and Bring Down

First, we Divide, and then like 1-2-3,
Step 2 is Multiply—sometimes that socks it to me
Step 3 is Subtract, and it's a natural fact
That you Bring Down the next digit, and then go right back

To Divide, Multiply, Subtract, and Bring Down
That's Divide, Multiply, Subtract, and Bring Down

Specific Section:

When rapping on a problem, you can really get your kicks
So when 192 is divided by 6
We'll rap about division to find the right solution
That's quick and clean without arithmetic pollution

$$6\overline{)192}$$

We start with Divide. How many 6s are in 1?
Of course, there are none so that's easily done
So we try 19, divided by 6 is 3—so sweet
We write it down and just keep rappin' to the beat

$$\begin{array}{r} 3 \\ 6\overline{)192} \end{array}$$

Next we Multiply 6 × 3, that's 18
And we write it down below the 19
When we Subtract, the difference is 1
And when we Bring Down the 2, we're almost done

$$\begin{array}{r} 3 \\ 6\overline{)192} \\ -18 \\ \hline 12 \end{array}$$

We Divide, Multiply, Subtract, Bring Down
Divide, Multiply, Subtract, Bring Down

So back to Divide the 12 by 6. That's 2
Write it, Multiply it by 6 (we're nearly through)
Subtract 12 from 12 and write the zero difference down,
And there's nothing left for us to Bring Down

$$\begin{array}{r} 32 \\ 6\overline{)192} \\ -18 \\ \hline 12 \\ -12 \\ \hline 0 \end{array}$$

So read the answer that's written on the top
Say "32," and then we can stop
We've solved this little division algorithm
With some basic facts and the soulful rhythm

Of Divide, Multiply, Subtract, Bring Down
Divide, Multiply, Subtract, Bring Down

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BASIC MATH
UNIT II

SUPPLEMENT #4 — GEOMETRY TERMS WORD SEARCH

The following geometry terms are hidden in the puzzle below. Find and circle each term. Words may be spelled forward, backward, from top to bottom, or diagonally. A score of 8 is good, 10 is excellent, and 13 to 14 is super.

GEOMETRIC FIGURES
PERIMETER
LINEAL
PARALLEL
PERPENDICULAR
RIGHT ANGLE
RADIUS
DIAMETER
CIRCUMFERENCE
PI
AREA
VOLUME
CUBIC UNIT
CUBIC FOOT

G	B	F	P	E	R	I	M	E	T	E	R	R	D	C	L
K	E	N	Q	Y	S	Z	V	O	L	U	M	E	J	I	I
T	O	O	F	C	I	B	U	C	B	F	K	T	Z	R	N
D	N	M	M	K	W	N	V	C	B	H	I	E	L	C	E
U	B	M	J	E	G	J	K	P	I	N	F	M	M	U	A
G	K	R	C	H	T	L	A	D	U	D	L	A	B	M	L
X	S	U	I	D	A	R	Q	C	R	H	L	I	C	F	Q
C	G	R	M	G	A	G	I	H	S	T	S	D	R	E	M
F	C	G	J	L	E	B	L	C	K	G	M	P	B	R	R
G	K	N	L	V	U	C	B	W	F	T	M	S	R	E	D
R	S	E	D	C	D	B	C	F	T	I	L	J	N	N	P
B	L	D	T	R	I	G	H	T	A	N	G	L	E	C	T
P	G	X	C	W	M	D	S	N	W	H	C	U	Q	E	P
W	A	E	R	A	D	P	G	B	F	C	D	H	R	L	N
C	L	S	W	R	T	R	G	V	Y	M	B	H	B	E	W
P	E	R	P	E	N	D	I	C	U	L	A	R	X	C	S

BASIC MATH
UNIT II

SUPPLEMENT #5 — CROSSNUMBER PUZZLE OF MATH PROBLEMS

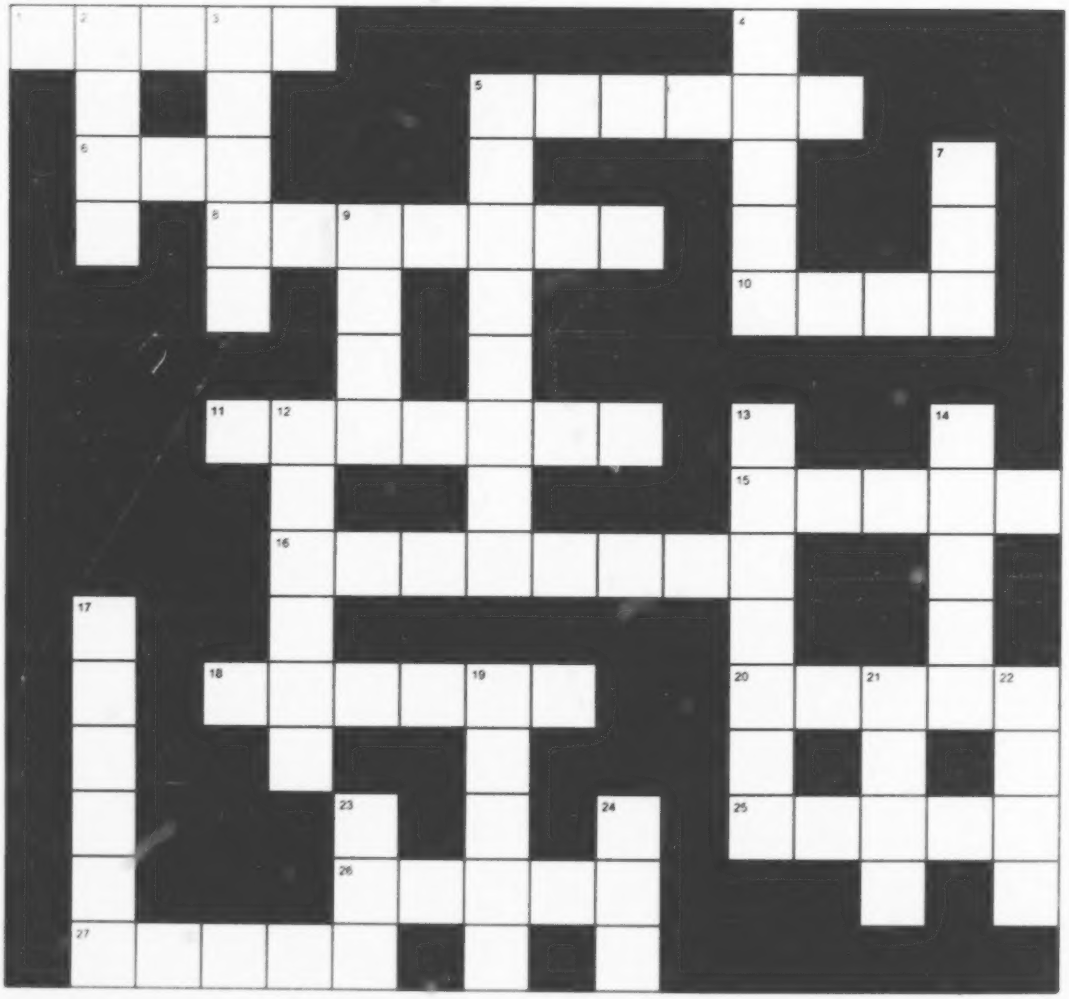
ACROSS CLUES

1. Subtract 12345 from 66666
5. Add 40% of 9835 to 174598
6. 15% of 2500
8. Add 3737373 to 6251014
10. Subtract 3819 from 9183, add 2557
11. Add 373737 to 2408946
15. Multiply 1993 by 45
16. Add 62429422 to 22455422
18. Multiply 849 by 578
20. Add 13492 to 15432
25. Multiply 287 by 225
26. Triple 29843
27. 25% of 100000

DOWN CLUES

2. Multiply 827 by 5
3. Multiply 277 by 96
4. Multiply 437 by 31
5. Add 4691357 to 7654321
7. 17/20 of 460
9. Multiply 808 by 11
12. Subtract 225987 from 974386
13. Add 5678990 to 4161246
14. 15% of 193280
17. Add 180000 to 3562
19. Divide 590193 by 27
21. Multiply 378 by 25
22. Multiply 297 by 15
23. Multiply 18 by 10
24. Multiply 28 by 17, subtract 82

SUPPLEMENT #5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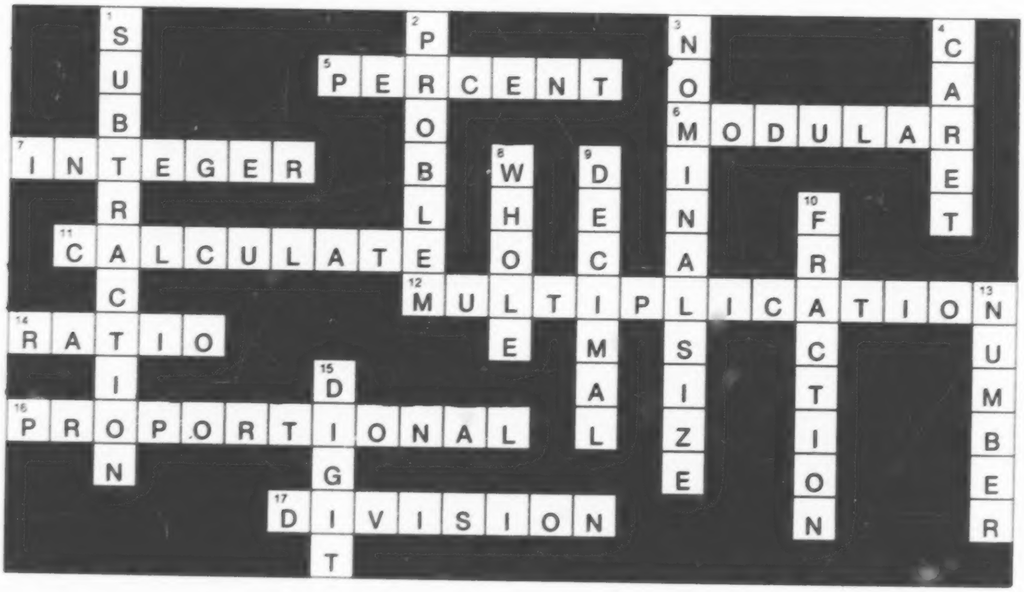
BASIC MATH
UNIT II

ANSWERS TO SUPPLEMENTS

Supplement #1


1 SUBTRACTION
2 PROBLEM
3 NOMINALSIZE
4 CARET
5 PERCENT
6 MODULAR
7 INTEGER
8 WHOLE
9 DECIMAL
10 FRACTION
11 CALCULATE
12 MULTIPLICATION
13 NUMBER
14 RATIO
15 DIGIT
16 PROPORTIONAL
17 DIVISION

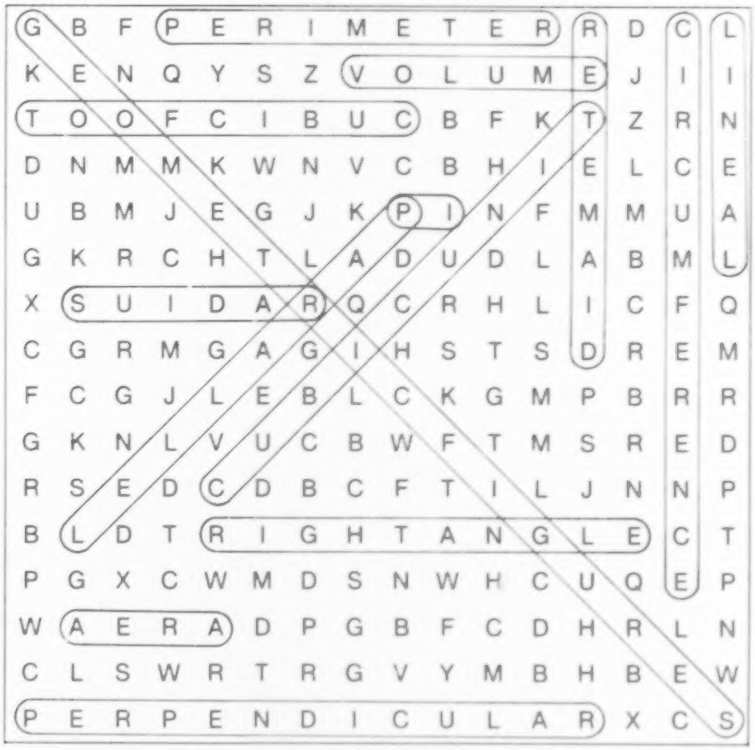
ANSWERS TO SUPPLEMENTS

Supplement #2

11−2 2	9 7−6 9−3	1 8−8 5	0 12−3
8−6 4 7−3	6 6−2 12−6 10−2	10−5 6 9−1 8−1	9 8 3
4 3 5	8 10−7 15−5 12−2	7 10 6−4 9−6	7−4 2 4
9−4 5	10 8−3 4	3 10−6 9−2	4−0 7

ANSWERS TO SUPPLEMENTS

Supplement #4



G	B	F	P	E	R	I	M	E	T	E	R	R	D	C	L
K	E	N	Q	Y	S	Z	V	O	L	U	M	E	J	I	I
T	O	O	F	C	I	B	U	C	B	F	K	T	Z	R	N
D	N	M	M	K	W	N	V	C	B	H	I	E	L	C	E
U	B	M	J	E	G	J	K	P	I	N	F	M	M	U	A
G	K	R	C	H	T	L	A	D	U	D	L	A	B	M	L
X	S	U	I	D	A	R	Q	C	R	H	L	I	C	F	Q
C	G	R	M	G	A	G	I	H	S	T	S	D	R	E	M
F	C	G	J	L	E	B	L	C	K	G	M	P	B	R	R
G	K	N	L	V	U	C	B	W	F	T	M	S	R	E	D
R	S	E	D	C	D	B	C	F	T	I	L	J	N	N	P
B	L	D	T	R	I	G	H	T	A	N	G	L	E	C	T
P	G	X	C	W	M	D	S	N	W	H	C	U	Q	E	P
W	A	E	R	A	D	P	G	B	F	C	D	H	R	L	N
C	L	S	W	R	T	R	G	V	Y	M	B	H	B	E	W
P	E	R	P	E	N	D	I	C	U	L	A	R	X	C	S

ANSWERS TO SUPPLEMENTS

Supplement #5

1 5	2 4	3	3 2	1							4 1				
	1		6				5 1	7	8	5	3	2			
	6 3	7	5				2				5			7 3	
	5		8 9	9	9 8	8	3	8	7		4			9	
			2		8		4				10 7	9	2	1	
					8		5								
			11 2	12 7	8	2	6	8	3		13 9			14 2	
				4			7				15 8	9	6	8	5
				16 8	4	8	8	4	8	4	4			9	
	17 1			3							0			9	
	8		18 4	9	0	7	19 2	2			20 2	8	21 9	2	22 4
	3			9			1				3		4		4
	5				23 1		8		24 3		25 6	4	5	7	5
	6				26 8	9	5	2	9				0		5
	27 2	5	0	0	0		9		4						

BASIC MATH
UNIT II

INFORMATION SHEET

I. Terms and definitions associated with basic math

A. **Whole number (integer)** — Any of the natural numbers, both positive and negative, that represents a complete item

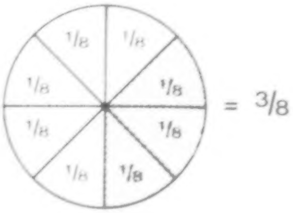
EXAMPLE: 25 is a whole number as opposed to $^3/_4$, a fraction or part of a whole.

B. **Digit** — Any one of the ten symbols, 0 to 9, by which all numbers can be expressed

C. **Fraction** — Part of a whole; represents one or more equal parts of a unit (Figure 1)

EXAMPLE:

FIGURE 1



D. **Decimal** — Fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the number

EXAMPLES: $0.1 = {}^1/_{10}$
$0.06 = {}^6/_{100}$
$0.003 = {}^3/_{1000}$

E. **Addition** — Process of totaling two or more numbers to find another number called a *sum*

EXAMPLE: $3 + 5 + 9 = 17$

F. **Subtraction** — Opposite (inverse) operation of addition

EXAMPLE: $8 - 4 = 4$ as opposed to $4 + 4 = 8$

G. **Multiplication** — Abbreviated process of adding a number to itself a specified number of times

EXAMPLE: $6 \times 3 = 18$ as opposed to $6 + 6 + 6 = 18$

INFORMATION SHEET

H. **Division** — Opposite (inverse) operation of multiplication

EXAMPLE: 16 ÷ 2 = 8 as opposed to 8 × 2 = 16

I. **Percent** — One part in a hundred; reckoned on the basis of a whole divided into one hundred parts

J. **Ratio** — Relationship in quantity, amount, or size between two or more things

K. **Proportional** — Being relatively equal in size or quantity

EXAMPLE: 1:1:3 = 0.5:0.5:1.5

L. **Nominal size** — Theoretical size that may vary from the actual

EXAMPLE: A 2×4 stud is actually $1\frac{1}{2}$ inches by $3\frac{1}{2}$ inches.

M. **Modular** — Pertaining to nominal units based on a 4-inch module

N. **Calculate** — To solve by mathematical process

O. **Problem** — Mathematical proposition

II. Symbols used with math problems (Table 1)

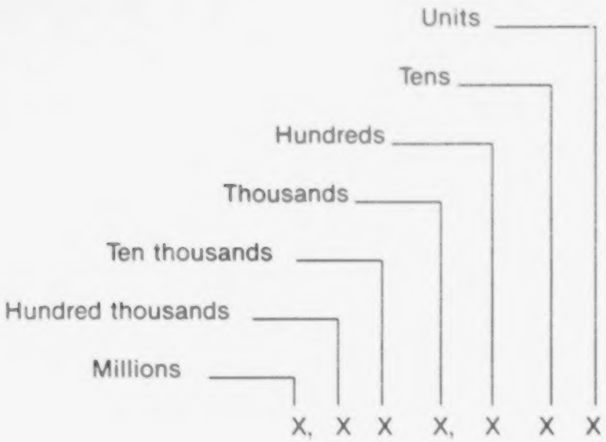
TABLE 1

Name of symbol	Symbol
Plus sign (addition)	+
Minus sign (subtraction)	−
Times sign (multiplication)	×
Division sign	÷
Division frame	$\overline{)\quad}$
Equal sign	=
Decimal point	.
Percent symbol	%
Ratio symbol	:
Pi sign	π

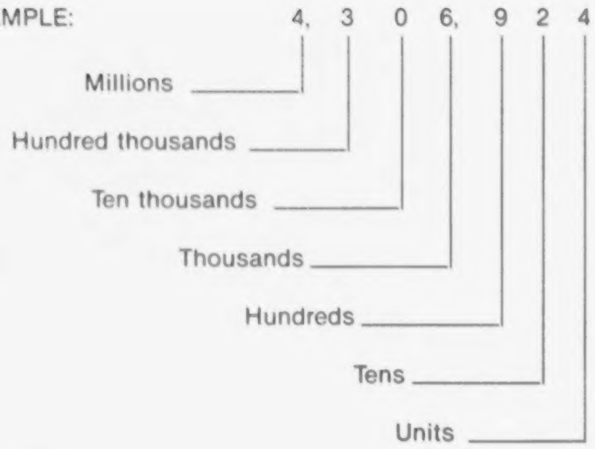
INFORMATION SHEET

III. Place values of a whole number

(NOTE: The position of a digit in a number shows how much that digit is worth. These positions are called *place values*.)


Units
Tens
Hundreds
Thousands
Ten thousands
Hundred thousands
Millions
X, X X X, X X X

EXAMPLE:


4, 3 0 6, 9 2 4
Millions
Hundred thousands
Ten thousands
Thousands
Hundreds
Tens
Units

(NOTE: The number in this example is four million, three hundred six thousand, nine hundred twenty-four.)

INFORMATION SHEET

IV. Adding whole numbers

A. Set up problem by writing units under units, tens under tens, and so on

EXAMPLE: Add the whole numbers 1632, 17, 550.

$$\begin{array}{r} 1632 \\ 17 \\ +\ 550 \\ \hline \end{array}$$

B. Add each column separately, beginning at top of units column

EXAMPLE:

$$\begin{array}{r} 1632 \\ 17 \\ +\ 550 \\ \hline 9 \end{array} \qquad \begin{array}{r} 1632 \\ 17 \\ +\ 550 \\ \hline 99 \end{array}$$

C. If the sum of any column is two or more digits, write the units digit in your answer and carry the remaining digit(s) to the top of next column to the left

EXAMPLE:

$$\begin{array}{r} \\ 1632 \\ 17 \\ \text{Write units} \quad +\ 550 \\ \hline \text{digit.} \quad \rightarrow 199 \end{array} \qquad \begin{array}{r} 1 \leftarrow \\ 1632 \\ 17 \\ +\ 550 \\ \hline 199 \end{array} \quad \begin{array}{l} \text{Carry remaining} \\ \text{digit.} \end{array}$$

D. Add any carried digit(s) above the column with that column

EXAMPLE:

$$\begin{array}{r} 1 \\ 1632 \\ 17 \\ +\ 550 \\ \hline 2199 \end{array} \quad \text{Carried Digit}$$

V. Subtracting whole numbers

A. Set up problem by writing units under units, tens under tens, and so on

(NOTE: The top number in the problem [original number] is almost always larger than the bottom number [subtracted number].)

EXAMPLE: Subtract 91 from 123.

$$\begin{array}{rl} 123 & \text{Original Number} \\ -\ 91 & \text{Subtracted Number} \\ \hline \end{array}$$

B. Subtract each column separately, beginning at bottom of units column

EXAMPLE:

$$\begin{array}{r} 123 \\ -\ 91\uparrow \\ \hline 2 \end{array}$$

INFORMATION SHEET

C. If a digit in the subtracted number is larger than the digit above it, "borrow" 1 from the top digit in the next column to the left, decreasing that digit by one and increasing the digit being subtracted from by ten

EXAMPLE:

$$\begin{array}{r} \overset{0}{1}23 \\ -\ \ 91 \\ \hline 32 \end{array}$$

D. If there is nothing to borrow in the next left column (column contains a zero), first borrow for that column from its next left column

EXAMPLE:

$$\begin{array}{r} \overset{8}{9}\overset{10}{0}6 \\ -318 \\ \hline \end{array} \qquad \begin{array}{r} \overset{8}{9}\overset{\overset{9}{10}}{0}6 \\ -318 \\ \hline 8 \end{array} \qquad \begin{array}{r} \overset{8}{9}\overset{\overset{9}{10}}{0}6 \\ -318 \\ \hline 88 \end{array} \qquad \begin{array}{r} \overset{8}{9}\overset{\overset{9}{10}}{0}6 \\ -318 \\ \hline 588 \end{array}$$

E. Check your subtraction by adding your answer to the subtracted number

EXAMPLE:

Problem		Check	
271	Original Number	271	Original Number
−164	Subtracted Number	−164	
107	Answer	+ 107	
		271	Check Answer

(NOTE: If you have solved the problem correctly, your check answer should be the same as the original number.)

VI. Multiplying whole numbers

A. Set up problem by writing the larger number (original number) above the smaller number (multiplier), writing units under units, tens under tens, and so on

(NOTE: You will get the correct answer [product] no matter which number is placed above the other, but the faster method places the larger above the smaller.)

EXAMPLE: Multiply the numbers 53 and 4.

53	Original Number
× 4	Multiplier

INFORMATION SHEET

B. If the multiplier contains only one digit, multiply each digit in the original number by it, working from right to left

1. Multiply units digit in original number by multiplier

2. Write answer units digit and insert necessary carry digit above next left column in original number as required

EXAMPLE:

$$\begin{array}{r} {}^{1} \\ 53 \\ \uparrow \\ \times\ \ 4 \\ \hline 2 \end{array}$$

3. Multiply tens digit by multiplier and add carried digit as required

EXAMPLE:

$$\begin{array}{r} {}^{1} \\ 53 \\ \nwarrow \\ +\ \ 4 \\ \hline 212 \end{array}$$

C. If the multiplier contains more than one digit, find partial products

1. Multiply each digit in original number by each digit in multiplier, moving from right to left

2. Align partial products so that right-hand digit of each is directly under its corresponding digit in the multiplier

EXAMPLE: Multiply the numbers 174 and 42.

$$\begin{array}{rrrrrr} & {}^{1} & {}^{1} & {}^{1} & {}^{2\,1} & {}^{2} \\ 174 & 174 & 174 & 174 & 174 & 174 \\ \uparrow & \nwarrow & \nwarrow & \nearrow & \uparrow & \nwarrow \\ \times\ 42 & \times\ 42 & \times\ 42 & \times\ 42 & \times\ 42 & \times\ 42 \\ \hline 8 & 48 & 348 & 348 & 348 & 348 \\ & & & 6 & 96 & 696 \\ & & \uparrow & & & \uparrow \\ & & \text{First Partial Product} & & & \text{Second Partial Product} \end{array}$$

D. Add the partial products

EXAMPLE:

$$\begin{array}{r} 174 \\ \times\ 42 \\ \hline 348 \\ +\ 696 \\ \hline 7308 \end{array} \leftarrow \text{Answer (Product)}$$

INFORMATION SHEET

VII. Dividing whole numbers

A. Set up problem by writing original number (number to be divided) inside a division frame, and by writing divisor (number you are dividing by) outside frame

EXAMPLE: How many times will 34 go into 3347?

Divisor $34\overline{)3347}$ Original Number

B. Determine how many times the divisor will go into the first digit of the original number; if it will not, write a zero in the answer space directly above the first digit, and then determine how many times the divisor will go into the first two numbers of the original number

(NOTE: Continue trying to divide the original number by the divisor until a set of digits can be divided. Remember to write a zero each time the set of digits cannot be divided.)

EXAMPLE:

$$\begin{array}{r} 0 \\ 34\overline{)3347} \end{array}$$

34 goes into 3 zero times.

$$\begin{array}{r} 00 \\ 34\overline{)3347} \end{array}$$

34 goes into 33 zero times.

$$\begin{array}{r} 009 \\ 34\overline{)3347} \end{array}$$

34 goes into 334 nine times.

C. Multiply the divisor by the answer (digit above frame); write this answer under the digit(s) that divisor went into, and subtract

EXAMPLE:

$$\begin{array}{r} 34 \\ \times\ 9 \\ \hline 306 \end{array}$$

Multiply divisor (34) by answer (9).

$$\begin{array}{r} 009 \\ 34\overline{)3347} \\ -\ 306 \\ \hline 28 \end{array}$$

Write answer under 334, the digits divisor went into, and subtract.

D. Bring down next unused digit from original number, and place it to the right of the subtracted difference (remainder)—even if the remainder is zero

EXAMPLE:

$$\begin{array}{r} 009 \\ 34\overline{)3347} \\ 306\downarrow \\ \hline 287 \end{array}$$

INFORMATION SHEET

E. Determine how many times the divisor will go into this new number; write your answer in the answer space above the digit that was brought down

EXAMPLE:

```
       0098
    34)3347
       306
        287
```

F. Multiply the divisor by the last digit you wrote in the answer; write this product under the digits that divisor went into, and subtract

EXAMPLE:

```
     34    Multiply divisor (34) by
    × 8    last digit of answer (8).
    272
```

```
       0098
    34)3347
       306      Write product under 287, the digits that divisor went
        287     into, and subtract.
      - 272
         15
```

G. Continue this process until all numbers in the original number are used

H. Write any remaining subtracted difference as a remainder

EXAMPLE:

```
      0098
    34)3347
       306
        287
        272
         15 Remainder
```

I. Check your answer by multiplying your answer times the divisor and adding the remainder to this number

(NOTE: If you have solved the problem correctly, your check answer should be the same as your original number.)

EXAMPLE:

```
       98    Answer
      ×34    Divisor
      392
     294
     3332
    +  15    Remainder
     3347    Check Answer (Same as original number)
```

INFORMATION SHEET

VIII. Types of fractions

A. Proper — Top number of fraction (numerator) is smaller than bottom number of fraction (denominator)

EXAMPLE: $\frac{7}{8}$ $\begin{matrix}\text{Numerator}\\\text{Denominator}\end{matrix}$

B. Improper — Top number of fraction (numerator) is the same as or larger than bottom number of fraction (denominator)

EXAMPLES: $\frac{9}{8}$ $\frac{16}{16}$

C. Mixed numbers — Contains a whole number and a proper fraction

EXAMPLES: $9\frac{1}{2}$, $1\frac{7}{8}$, $4\frac{3}{4}$

IX. Reducing fractions to lowest terms — Divide the numerator and denominator by the largest whole number that will go into each evenly

EXAMPLE: Reduce $\frac{4}{16}$ to its lowest terms.

$$\frac{4}{16} = \frac{4 \div 4}{16 \div 4} = \frac{1}{4}$$

(NOTE: The fraction $\frac{1}{4}$ is reduced to its lowest term because the numerator [1] and the denominator [4] cannot be divided by the same number.)

X. Converting mixed numbers to improper fractions

A. Multiply the whole number by the denominator of the fraction

EXAMPLE: Convert $4\frac{3}{8}$ to an improper fraction.

$8 \times 4 = 32$

B. Add your answer to the numerator

EXAMPLE: $32 + 3 = 35$

C. Place this sum over the original denominator

EXAMPLE: $\frac{35}{8}$ Improper Fraction

INFORMATION SHEET

XI. Convert improper fractions to mixed numbers

A. Divide the numerator by the denominator

EXAMPLE: Convert $^{18}/_{15}$ to a mixed number.

$$\begin{array}{r} 01 \\ 15\overline{)18} \\ \underline{15} \\ 3\ \text{Remainder} \end{array}$$

B. Place the remainder over the denominator

EXAMPLE: $\dfrac{3}{15}\begin{array}{l}\text{Remainder}\\ \text{Denominator}\end{array}$

C. Reduce this fraction if necessary

EXAMPLE: $\dfrac{3}{15} = \dfrac{3 \div 3}{15 \div 3} = \dfrac{1}{5}$

D. Add the reduced fraction to the whole number obtained by dividing the numerator by the denominator

EXAMPLE: $1 + \dfrac{1}{5} = 1\dfrac{1}{5}$ Mixed Number

XII. Adding fractions

A. Like fractions

(NOTE: Like fractions are those having the same, or common, denominators.)

EXAMPLES: $^{1}/_{4}$ and $^{2}/_{4}$, $^{5}/_{8}$ and $^{5}/_{8}$, $^{1}/_{16}$ and $^{1}/_{16}$

1. Add the numerators
2. Place sum of numerators over common denominator
3. Convert to mixed numbers and reduce as required

EXAMPLE 1: Add $^{1}/_{4}$ and $^{2}/_{4}$.

$$\frac{1}{4} + \frac{2}{4} = \frac{1 + 2}{4} = \frac{3}{4}$$

EXAMPLE 2: Add $^{5}/_{8}$ and $^{5}/_{8}$.

$$\frac{5}{8} + \frac{5}{8} = \frac{5 + 5}{8} = \frac{10}{8} = 10 \div 8 = 1\frac{2}{8} = 1\frac{1}{4}$$

INFORMATION SHEET

EXAMPLE 3: Add $^{1}/_{16}$ and $^{3}/_{16}$.

$$\frac{1}{16} + \frac{3}{16} = \frac{1+3}{16} = \frac{4}{16} = \frac{4 \div 4}{16 \div 4} = \frac{1}{4}$$

B. Unlike fractions

EXAMPLES: $^{11}/_{12}$ and $^{3}/_{9}$, $^{1}/_{8}$ and $^{3}/_{4}$

1. Change to like fractions

   a. Find the lowest number into which each denominator can be divided evenly (lowest common denominator)

   b. Multiply the numerators and denominators of each fraction by the number of times its denominator can be divided into the lowest common denominator

EXAMPLE 1: Add $^{11}/_{12}$ and $^{3}/_{9}$.

36 is lowest number into which both 12 and 9 can be divided evenly.

$36 \div 12 = 3$

$36 \div 9 = 4$

$$\frac{11}{12} = \frac{11 \times 3}{12 \times 3} = \frac{33}{36}$$

$$\frac{3}{9} = \frac{3 \times 4}{9 \times 4} = \frac{12}{36}$$

EXAMPLE 2: Add $^{1}/_{8}$ and $^{3}/_{4}$.

8 is the lowest number into which both 8 and 4 can be divided evenly.

$8 \div 8 = 1$

$8 \div 4 = 2$

$\frac{1}{8}$ remains as $^{1}/_{8}$ because 8 is the common denominator.

$$\frac{3}{4} = \frac{3 \times 2}{4 \times 2} = \frac{6}{8}$$

INFORMATION SHEET

2. Add as like fractions and reduce or convert to mixed numbers as required

EXAMPLE 1: Add $^{11}/_{12}$ and $^{3}/_{9}$.

$$\frac{11}{12} = \frac{33}{36} \text{ and } \frac{3}{9} = \frac{12}{36}$$

$$\frac{33}{36} + \frac{12}{36} = \frac{33 + 12}{36} = \frac{45}{36} = \frac{5}{4} = 1\frac{1}{4}$$

EXAMPLE 2: Add $^{1}/_{8}$ and $^{3}/_{4}$.

$$\frac{1}{8} \text{ remains } \frac{1}{8} \text{ and } \frac{3}{4} = \frac{6}{8}$$

$$\frac{1}{8} + \frac{6}{8} = \frac{1 + 6}{8} = \frac{7}{8}$$

C. Mixed numbers

1. Add whole numbers

2. Add fractions, first finding common denominators if necessary, and reduce or convert to mixed numbers as necessary

3. Add the sums of steps 1 and 2

EXAMPLE 1: Add $3^{1}/_{8}$ and $7^{3}/_{8}$.

$3 + 7 = 10$ Add whole numbers.

$\frac{1}{8} + \frac{3}{8} = \frac{1 + 3}{8} = \frac{4}{8} = \frac{1}{2}$ Add fractions and reduce.

$10 + \frac{1}{2} = 10\frac{1}{2}$ Add the sums of steps 1 and 2.

EXAMPLE 2: Add $4^{2}/_{3}$ and $1^{5}/_{6}$.

$4 + 1 = 5$ Add whole numbers.

$\frac{2}{3} + \frac{5}{6} = \frac{4}{6} + \frac{5}{6}$ Find common denominator.

$\frac{4}{6} + \frac{5}{6} = \frac{9}{6} = 1\frac{3}{6} = 1\frac{1}{2}$ Add fractions, convert to mixed number, and reduce.

$5 + 1\frac{1}{2} = 6\frac{1}{2}$ Add sums of steps 1 and 2.

INFORMATION SHEET

XIII. Subtracting fractions

A. Like fractions

1. Subtract smaller numerator from larger numerator

EXAMPLE: Subtract $^1/_{16}$ from $^7/_{16}$.

$7 - 1 = 6$

2. Place subtraction answer over common denominator

EXAMPLE: $\frac{6}{16}$

3. Reduce to lowest terms as required

EXAMPLE: $\frac{6}{16} = \frac{3}{8}$

B. Unlike fractions

1. Change to like fractions

EXAMPLE: Subtract $^1/_2$ from $^3/_4$.

$\frac{3}{4}$ remains the same because 4 is the common denominator.

$$\frac{1}{2} = \frac{1 \times 2}{2 \times 2} = \frac{2}{4}$$

2. Subtract as for like fractions

EXAMPLE: $\frac{3}{4} - \frac{2}{4} = \frac{3 - 2}{4} = \frac{1}{4}$

3. Reduce to lowest terms as required

C. Mixed numbers

1. Convert mixed numbers to like fractions

EXAMPLE: Subtract $3^1/_2$ from $5^1/_8$.

$$5\frac{1}{8} - 3\frac{1}{2} =$$

$$5\frac{1}{8} - 3\frac{4}{8}$$

INFORMATION SHEET

2. Borrow a one from the original whole number if needed, convert the one to a like fraction, and add it to the smaller fraction

   (NOTE: This step is needed only if the like fraction in the original number is smaller than the like fraction in the subtracted number.)

   EXAMPLE: $5\frac{1}{8} - 3\frac{4}{8} =$

   $(4\frac{8}{8} + \frac{1}{8}) - 3\frac{4}{8} =$

   $4\frac{9}{8} - 3\frac{4}{8}$

3. Subtract whole number from whole number and like fraction from like fraction

   EXAMPLE: $4\frac{9}{8} - 3\frac{4}{8} = 1\frac{5}{8}$

XIV. Multiplying fractions

A. Convert mixed numbers to improper fractions if necessary

B. Multiply numerators by numerators and denominators by denominators

C. Write the product of the numerators over the product of the denominators

D. Convert improper fractions to mixed numbers and reduce as required

EXAMPLE 1: Multiply $^1/_2$ by $^3/_4$.

$$\frac{1}{2} \times \frac{3}{4} = \frac{1 \times 3}{2 \times 4} = \frac{3}{8}$$

EXAMPLE 2: Multiply $1^1/_4$ by $^1/_2$.

$1\frac{1}{4} = \frac{5}{4}$ Convert to improper fraction.

$$\frac{5}{4} \times \frac{1}{2} = \frac{5 \times 1}{4 \times 2} = \frac{5}{8}$$

XV. Dividing fractions

(NOTE: Dividing fractions is just like multiplying fractions—except for the inversion step.)

A. Convert mixed numbers to improper fractions if necessary

B. Invert the second fraction—the divisor

C. Multiply numerators by numerators and denominators by denominators

INFORMATION SHEET

D. Write the product of the numerators over the product of the denominators

E. Convert improper fractions to mixed numbers and reduce as required

EXAMPLE 1: Divide 7/8 by 1/4.

$$\frac{7}{8} \div \frac{1}{4} = \frac{7}{8} \times \frac{4}{1} = \frac{7 \times 4}{8 \times 1} = \frac{28}{8} = 3\frac{4}{8} = 3\frac{1}{2}$$

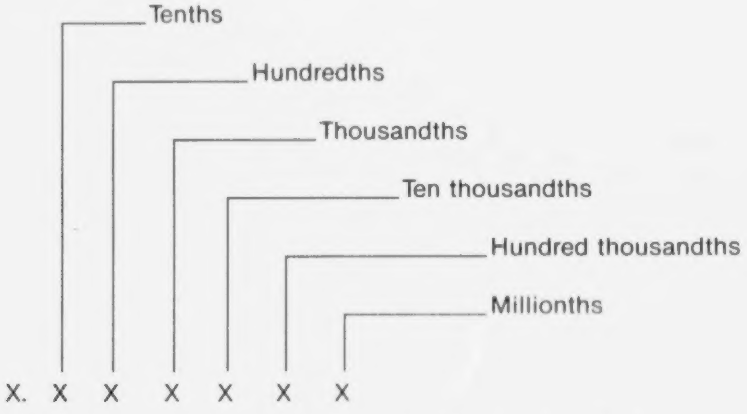
EXAMPLE 2: Divide 1 1/4 by 1/2.

$$1\frac{1}{4} \div \frac{1}{2} = \frac{5}{4} \div \frac{1}{2} = \frac{5}{4} \times \frac{2}{1} = \frac{5 \times 2}{4 \times 1} = \frac{10}{4} = 2\frac{2}{4} = 2\frac{1}{2}$$

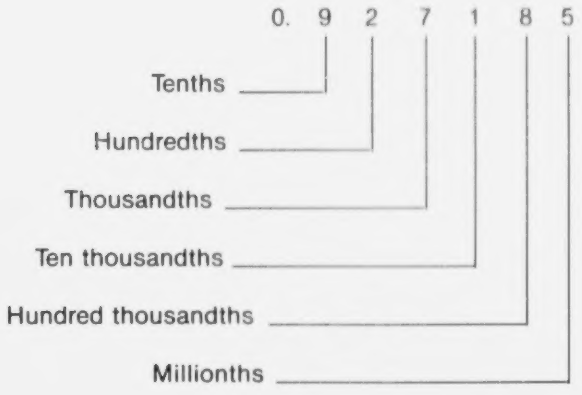
EXAMPLE 3: Divide 5 by 3/4.

$$5 \div \frac{3}{4} = \frac{5}{1} \div \frac{3}{4} = \frac{5}{1} \times \frac{4}{3} = \frac{5 \times 4}{1 \times 3} = \frac{20}{3} = 6\frac{2}{3}$$

XVI. Place values of decimal numbers


Tenths
Hundredths
Thousandths
Ten thousandths
Hundred thousandths
Millionths
X. X X X X X X

EXAMPLE:


0. 9 2 7 1 8 5
Tenths
Hundredths
Thousandths
Ten thousandths
Hundred thousandths
Millionths

(NOTE: The number in the example is read as nine hundred twenty-seven thousand, one hundred eighty-five millionths.)

INFORMATION SHEET

XVII. Adding decimal numbers

A. Set up problem as for addition of whole numbers, aligning decimal points directly under each other

(NOTE: Zeros may be added to ensure that units line up under units, tens under tens, and so on. Whole numbers have an understood decimal point to the right of the units digit: 7 is 7., 75 is 75., and 754 is 754.)

EXAMPLE: Add 0.857, 2.1, 753, and 370.057.

$$\begin{array}{rcr} 0.857 & & 000.857 \\ 2.1 & & 002.100 \\ 753 & \text{or} & 753.000 \\ \underline{+\ 370.057} & & \underline{+\ 370.057} \end{array}$$

B. Add each column of numbers as for whole numbers

C. Locate the decimal point in the answer by placing it directly under the decimal points above

EXAMPLE:

$$\begin{array}{rl} 000.857 & \\ 002.100 & \\ 753.000 & \\ \underline{+\ 370.057} & \\ 1126.014 & \text{Answer} \end{array}$$

XVIII. Subtracting decimal numbers

A. Set up problem as for subtraction of whole numbers, aligning decimal points directly under each other

EXAMPLE: Subtract 1.397 from 8.120.

$$\begin{array}{rl} 8.120 & \text{Original Number} \\ \underline{-\ 1.397} & \text{Subtracted Number} \end{array}$$

B. Subtract each column of numbers as for whole numbers

C. Locate the decimal point in the answer by placing it directly under the decimal points above

D. Check your subtraction by adding your answer to the subtracted number

(NOTE: If you have solved the problem correctly, your check answer should be the same as the original number.)

EXAMPLE:

$$\begin{array}{rl} 8.120 & \text{Original Number} \\ \underline{-\ 1.397} & \text{Subtracted Number} \\ \underline{+\ 6.723} & \text{Answer (Difference)} \\ 8.120 & \text{Check Answer} \end{array}$$

INFORMATION SHEET

XIX. Multiplying decimal numbers

A. Set up problem and multiply as for multiplication of whole numbers

(NOTE: Do *not* align the decimal points in columns when setting up multiplication problems for decimal numbers.)

EXAMPLE: Multiply 27.935 by 7.07.

$$\begin{array}{r l} 27.935 & \text{Original Number} \\ \times\quad 7.07 & \text{Multiplier} \\ \hline 195545 & \\ 1955450 & \\ \hline 19750045 & \end{array}$$

B. Add the number of decimal places to the right of the decimal points in the multiplier and original number

EXAMPLE:

$$\begin{array}{r} 27.935 \\ \times\quad 7.07 \\ \hline \end{array} \qquad\qquad \begin{array}{r l} 3 & \text{Decimal Places} \\ +2 & \text{Decimal Places} \\ \hline 5 & \text{Total Decimal Places} \end{array}$$

C. Locate decimal point in answer by beginning at far right digit and counting off as many places to the left as the total decimal places found in Step B

EXAMPLE:

$$\begin{array}{r l} 27.935 & \\ \times\quad 7.07 & \\ \hline 195545 & \\ 1955450 & \\ \hline 197.50045 & \text{5 Decimal Places} \end{array}$$

XX. Dividing decimal numbers

A. Set up problem as for division of whole numbers

EXAMPLE: Divide 0.25 by 0.005.

Divisor $0.005\overline{)0.25}$ Original Number

B. Move the decimal point in the divisor to the right of the far right digit in the divisor

EXAMPLE: $0.\underset{\curvearrowright}{005}.\overline{)0.25}$

C. Move the decimal point in the original number to the right by the same number of decimal places that you moved the decimal point in the divisor, adding zeros to the original number if necessary

EXAMPLE: $0.\underset{\curvearrowright}{005}.\overline{)0.\underset{\curvearrowright}{250}.}$

(NOTE: If you are dividing a decimal number into a whole number, remember that whole numbers have an understood decimal point to the right of the units digit.)

EXAMPLE: $0.03\overline{)9}$ becomes $0.\underset{\curvearrowright}{03}.\overline{)9.\underset{\curvearrowright}{00}.}$

INFORMATION SHEET

D. Place a decimal point in the answer space directly above the repositioned decimal point in the original number

EXAMPLE: 0.005.)0.250.

E. Divide as for whole numbers

EXAMPLE:

$$\begin{array}{r} 50. \\ 0005.\overline{)0250.} \\ \underline{025} \\ 00 \end{array}$$

F. Check your division by multiplying the original divisor (before decimal point was moved) by your answer and adding any remainder to this number

(NOTE: If you have solved the problem correctly, your check answer should be the same as the original number.)

EXAMPLE:

0.005 Divisor
× 50 Answer
0.250 Check Answer (Same as Original Number)

XXI. Converting fractions to decimals and percentages

A. Fractions to decimals — Divide the numerator by the denominator

EXAMPLE: Convert 5/8 to a decimal.

5 Numerator
8 Denominator

$$\begin{array}{r} 0.625 \\ 8\overline{)5.000} \\ \underline{4\,8} \\ 20 \\ \underline{16} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

B. Fractions to percentages

(NOTE: *Percent* means that a number is a fraction of 100.)

1. Convert the fractions to decimals by dividing numerator by denominator
2. Move the decimal point in the answer two places to the right
3. Place the percent symbol after the number

EXAMPLE: Convert 7/33 to a percentage.

7 Numerator
33 Denominator

$$\begin{array}{r} 0.2121 = 21.21\% \\ 33\overline{)7.0000} \\ \underline{6\,6} \\ 40 \\ \underline{33} \\ 70 \\ \underline{66} \\ 40 \\ \underline{33} \\ 7 \end{array}$$

INFORMATION SHEET

XXII. Decimal and fractional equivalents

Fraction	Decimal
1/64	.015625
1/32	.03125
3/64	.046875
1/16	.0625
5/64	.078125
3/32	.09375
7/64	.109375
1/8	**.125**
9/64	.140625
5/32	.15625
11/64	.171875
3/16	.1875
13/64	.203125
7/32	.21875
15/64	.234375
1/4	**.25**
17/64	.265625
9/32	.28125
19/64	.296875
5/16	.3125
21/64	.328125
11/32	.34375
23/64	.359375
3/8	**.375**
25/64	.390625
13/32	.40625
27/64	.421875
7/16	.4375
29/64	.453125
15/32	.46875
31/64	.484375
1/2	**.5**
33/64	.515625
17/32	.53125
35/64	.546875
9/16	.5625
37/64	.578125
19/32	.59375
39/64	.609375
5/8	**.625**
41/64	.640625
21/32	.65625
43/64	.671875
11/16	.6875
45/64	.703125
23/32	.71875
47/64	.734375
3/4	**.75**
49/64	.765625
25/32	.78125
51/64	.796875
13/16	.8125
53/64	.828125
27/32	.84375
55/64	.859375
7/8	**.875**
57/64	.890625
29/32	.90625
59/64	.921875
15/16	.9375
61/64	.953125
31/32	.96875
63/64	.984375
1	**1.**

INFORMATION SHEET

XXIII. Converting percentages to fractions and decimal numbers

A. Percentages to fractions

1. Drop the percent symbol
2. Place the number over 100
3. Reduce to lowest terms if necessary

EXAMPLE: Convert 38% to a fraction.

$$38\% = 38 = \frac{38}{100} = \frac{19}{50}$$

B. Percentages to decimals

1. Drop the percent symbol
2. Move decimal point two places to left

EXAMPLE: Convert 74% to a decimal.

$$74\% = 74 = 0.74$$

XXIV. Solving percentage problems

(NOTE: Percentage problems may involve solving for the percent ["16 is what percent of 80?"], the part ["What number is 20% of 80?"], or the whole ["16 is 20% of what number?"].)

A. Write the unknown as "X"

EXAMPLE: 16 is what percent of 80?

16 is X percent of 80.

(NOTE: The unknown may be the percent, the part, or the whole.)

B. Write the percent (known or unknown) as a fraction with a denominator of 100

EXAMPLE: 16 is $\frac{X}{100}$ percent of 80.

INFORMATION SHEET

C. Write the part and the whole as a fraction, writing the part as the numerator and the whole as the denominator

EXAMPLE: $\frac{16}{80}\ \begin{matrix}\text{Part}\\ \text{Whole}\end{matrix}$

D. Set up the equation by writing the two fractions with an equal sign between them

EXAMPLE: $\frac{X}{100} = \frac{16}{80}$

E. Solve the equation by multiplying the numerator of each fraction by the denominator of the other

(NOTE: This process is known as *cross multiplying*.)

EXAMPLE: $\frac{X}{100} = \frac{16}{80}$

$80X = 1600$

F. Divide each side of the equation by the multiplier of X

EXAMPLE: $80X = 1600$

$X = 20\%$

16 is 20% of 80.

XXV. Terms used in geometry

A. **Geometric figure** — Shape formed by straight or curved lines

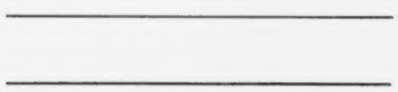
B. **Perimeter** — Outer limits or boundary

C. **Lineal** — Relating to, consisting of, or resembling a straight line

D. **Parallel** — Extending in the same direction; equal distance apart and never meeting (Figure 2)

EXAMPLE:

FIGURE 2

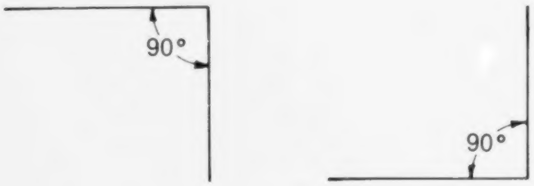


INFORMATION SHEET

E. **Right angle** — Angle formed by two lines perpendicular to each other; 90-degree angle (Figure 3)

EXAMPLE:

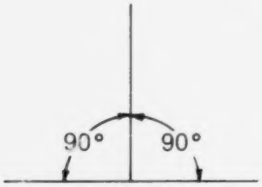
FIGURE 3



F. **Perpendicular** — Line or surface at a right angle to another line or surface (Figure 4)

EXAMPLE:

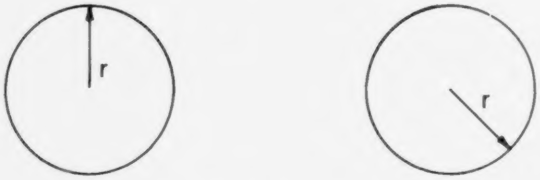
FIGURE 4



G. **Radius** — Line from center of a circle to any point on edge of circle (Figure 5)

EXAMPLE:

FIGURE 5

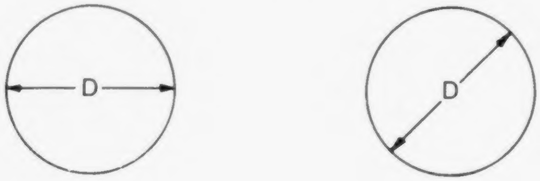


INFORMATION SHEET

H. **Diameter** — Distance between outer edges of a circle through center point (Figure 6)

EXAMPLE:

FIGURE 6



I. **Circumference** — Distance around outer edge of a circle

J. **Pi** — Greek letter (π) representing the ratio of a circle's circumference to its diameter; ratio approximately 3.1416

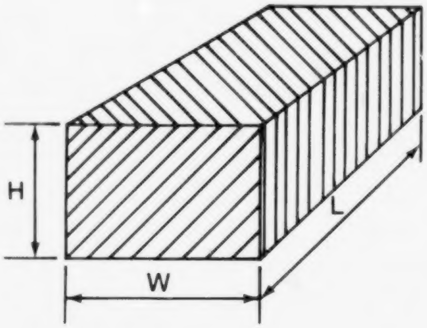
K. **Area** — Measure of a flat surface; expressed in square units

EXAMPLE: W × L = Area

L. **Volume** — Space occupied by a body; expressed in cubic units (Figure 7)

EXAMPLE:

FIGURE 7



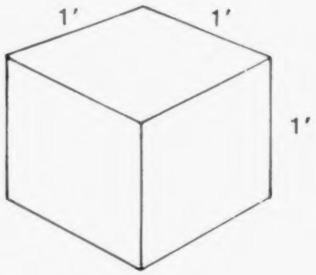
M. **Cubic unit** — Unit with three equal dimensions including length, width, and height

INFORMATION SHEET

N. **Cubic foot** — Volume of an object that is 1 foot long, 1 foot wide, and 1 foot high (Figure 8)

EXAMPLE:

FIGURE 8



XXVI. Types of geometric figures (Figures 9-15)

A. **Square** — Figure having four sides of equal length and four right angles

EXAMPLE:

FIGURE 9

B. **Rectangle** — Figure with two parallel ends of equal length, two parallel sides of equal length, and four right angles

EXAMPLE:

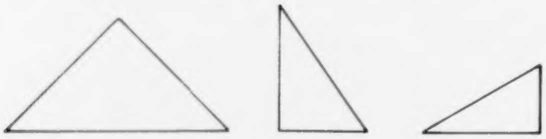
FIGURE 10

INFORMATION SHEET

C. **Triangle** — Figure having three sides and three angles

EXAMPLES:

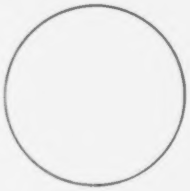
FIGURE 11



D. **Circle** — Flat, round figure formed by one curved line; all points of curved line are equidistant from center point

EXAMPLE:

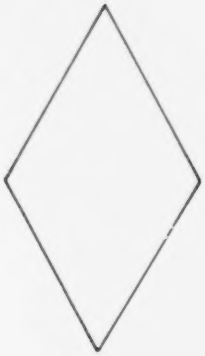
FIGURE 12



E. **Rhombus** — Figure having no right angles and four sides of equal length

EXAMPLE:

FIGURE 13



INFORMATION SHEET

F. **Parallelogram** — Figure such as a square, rectangle, or rhombus with two parallel ends of equal length and two parallel sides of equal length

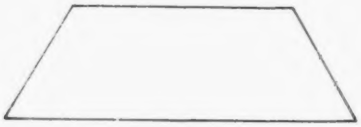
EXAMPLE:

FIGURE 14

G. **Trapezoid** — Figure with only one pair of parallel opposite sides

EXAMPLE:

FIGURE 15



XXVII. Units of measure and their equivalents

A. Inch (″) — Equal to one-twelfth of a foot (1/12′) or one thirty-sixth of a yard (1/36 yard)

B. Foot (′) — Equal to twelve inches (12″) or one-third of a yard (1/3 yard)

C. Yard — Equal to three feet (3′) or thirty-six inches (36″)

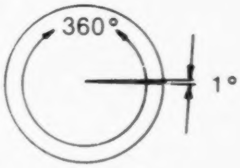
D. Rod — Equal to sixteen and one-half feet (16 1/2′)

E. Mile — Equal to five thousand, two hundred and eighty feet (5280′)

F. Degree (°) — Equal to 1/360 of a circle (Figure 16)

EXAMPLE:

FIGURE 16



INFORMATION SHEET

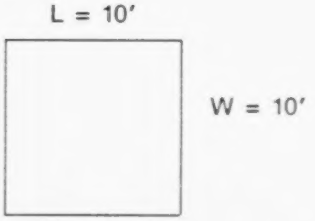
XXVIII. Calculating area of geometric figures (Figures 17-22)

(NOTE: Area is always labeled in square units of measure.)

A. Square — Use the formula Area = Length × Width or $A = LW$

EXAMPLE:

FIGURE 17

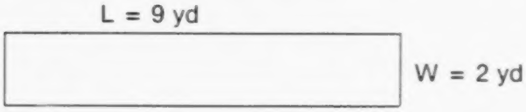


$$\begin{aligned} A &= LW \\ &= 10 \times 10 \\ &= 100 \text{ square feet} \end{aligned}$$

B. Rectangle — Use the formula Area = Length × Width or $A = LW$

EXAMPLE:

FIGURE 18



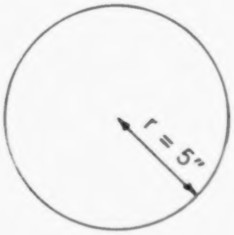
$$\begin{aligned} A &= LW \\ &= 9 \times 2 \\ &= 18 \text{ square yards} \end{aligned}$$

C. Circle — Use the formula Area = πr^2 (radius × radius)

(NOTE: Pi [π] is 3.14, which is the circumference of a circle divided by the diameter of the circle.)

EXAMPLE:

FIGURE 19



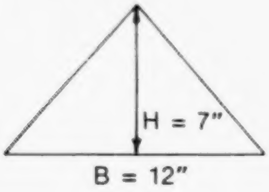
$$\begin{aligned} A &= \pi r^2 \\ &= 3.14 \times (5 \times 5) \\ &= 78.50 \text{ square inches} \end{aligned}$$

INFORMATION SHEET

D. Triangle — Use the formula Area = $\frac{1}{2}$ Base × Height, or A = $\frac{1}{2}$ BH

EXAMPLE:

FIGURE 20



$$A = \frac{1}{2} BH$$

$$= (\frac{1}{2} \times 12) \times 7$$

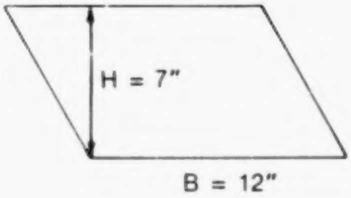
$$= 6 \times 7$$

$$= 42 \text{ square inches}$$

E. Parallelogram — Use the formula Area = Base × Height, or A = BH

EXAMPLE:

FIGURE 21



$$A = BH$$

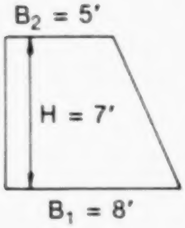
$$= 12 \times 7$$

$$= 84 \text{ square inches}$$

F. Trapezoid — Use the formula Area = $\frac{1}{2} H (B_1 + B_2)$

EXAMPLE:

FIGURE 22



$$A = \frac{1}{2} H (B_1 + B_2)$$

$$= (\frac{1}{2} \times 7) \times (8 + 5)$$

$$= \frac{7}{2} \times 13$$

$$= \frac{7}{2} \times \frac{13}{1}$$

$$= \frac{91}{2}$$

$$= 45\frac{1}{2} \text{ square feet}$$

INFORMATION SHEET

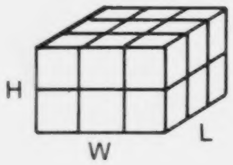
XXIX. Calculating volume of solid figures

(NOTE: Volume is always measured in cubic units.)

A. Using counting method — Use formula Cubic Units = Number of Cubes in Layer × Number of Layers (Figure 23)

EXAMPLE:

FIGURE 23



Cubic Units = Number of Cubes in Layer × Number of Layers

= 9 × 2

= 18 cubes

B. Using formula and converting as necessary

1. Using formula Volume = Length × Width × Height or V = LWH

EXAMPLE 1: Where L = 3 feet, W = $\frac{1}{2}$ foot, and H = $1\frac{1}{2}$ feet

$$V = LWH$$

$$= 3 \times \frac{1}{2} \times 1\frac{1}{2}$$

$$= \frac{9}{4} \text{ or } 2\frac{1}{4} \text{ cubic feet}$$

EXAMPLE 2: Where L = 10 feet, W = 8 feet, and H = 3 feet

$$V = LWH$$

$$= 10 \times 8 \times 3$$

$$= 240 \text{ cubic feet}$$

2. Converting using formula

$$\text{Cubic Yards} = \frac{\text{Width in Feet} \times \text{Length in Feet} \times \text{Thickness in Feet}}{27}$$

INFORMATION SHEET

(NOTE: The formula for converting will differ, depending on the units being converted. The formula for cubic yards is given in the example because it is the conversion most often used by construction workers. Because given measurements are usually in feet and inches, thickness in inches must be broken down by using fractions or decimals.)

EXAMPLE 1: Converting to yards, using fractions where width = 30′, length = 60′, and thickness = 4″

$$\text{Cubic Yards} = \frac{\text{Width in Feet} \times \text{Length in Feet} \times \text{Thickness in Feet}}{27}$$

$$= \frac{30' \times 60' \times 4''}{27}$$

$$= \frac{30' \times 60' \times 1/3'}{27}$$

$$= 22.22 \text{ cubic yards}$$

EXAMPLE 2: Converting to yards, using decimals where width = 30′, length = 60′, and thickness = 4″

$$\text{Cubic Yards} = \frac{\text{Width in Feet} \times \text{Length in Feet} \times \text{Thickness in Feet}}{27}$$

$$= \frac{30' \times 60' \times .33'}{27}$$

$$= \frac{594}{27}$$

$$= 22 \text{ cubic yards}$$

XXX. Solving ratio and proportion problems — To increase or decrease proportionally, multiply or divide each number in the ratio by the same number

(NOTE: Ratio indicates parts of material per mix; proportion indicates that the ratio is the same but the quantity may differ.)

EXAMPLE 1: You want to find half of the ratio 1:1:3.

Divide each number in the ratio by 2 to get 0.5:0.5:1.5.

EXAMPLE 2: You need three times the ratio 1:1:3.

Multiply each number in the ratio by 3 to get 3:3:9.

BASIC MATH
UNIT II

ASSIGNMENT SHEET #1 — ADD WHOLE NUMBERS

NAME ____ SCORE ________________

Like most people, you probably use addition every day. For example, today you probably added coins together to pay for sodas and snacks. Every time you add, you use basic addition facts. The following exercises will form part of your construction math background and serve as a basis for completing other exercises and problems.

EXAMPLES:

$$\begin{array}{r} 5 \\ +\ 10 \\ \hline 15 \end{array} \qquad \begin{array}{r} {\scriptstyle 1} \\ 67 \\ +\ 25 \\ \hline 92 \end{array} \leftarrow \text{Carried Digit} \qquad \begin{array}{r} {\scriptstyle 1\,1} \\ 539 \\ 333 \\ +\ 432 \\ \hline 1304 \end{array} \leftarrow \text{Carried Digits}$$

PART I

Solve each of the following addition problems. Refer to Information Sheet, Section IV, if necessary, and show your work.

A. $\begin{array}{r} 2 \\ +\ 9 \\ \hline \end{array}$ B. $\begin{array}{r} 8 \\ +\ 8 \\ \hline \end{array}$ C. $\begin{array}{r} 7 \\ +\ 6 \\ \hline \end{array}$ D. $\begin{array}{r} 15 \\ +\ 8 \\ \hline \end{array}$ E. $\begin{array}{r} 81 \\ +\ 27 \\ \hline \end{array}$

F. $\begin{array}{r} 7 \\ 38 \\ +\ 43 \\ \hline \end{array}$ G. $\begin{array}{r} 55 \\ 88 \\ +\ 99 \\ \hline \end{array}$ H. $\begin{array}{r} 341 \\ 428 \\ +\ 769 \\ \hline \end{array}$ I. $\begin{array}{r} 472 \\ 564 \\ +\ 881 \\ \hline \end{array}$ J. $\begin{array}{r} 9876 \\ 5432 \\ +\ 1122 \\ \hline \end{array}$

PART II

A. If a concrete mason used 330 lineal feet of two-by-fours on one form, 570 lineal feet on another, and 275 on another, how many lineal feet were used?

Total lineal feet = ______________

B. A contractor ordered the following number of doors at different dates: 256, 62, 575, and 242. How many doors should he be billed for?

Total doors = ______________

ASSIGNMENT SHEET #1

C. If a drywall contractor paid $480 for drywall, $13 for tape, $81 for joint compound, and $35 for screws, what was the total cost of the materials?

Total cost of materials = $____________

D. If it takes 1135 lineal feet of soil pipe for the first floor, 1225 lineal feet for the second, 1220 lineal feet for the third, 1125 lineal feet for the fourth, and 7425 lineal feet for the last floor, what would be the total lineal feet of soil pipe needed?

Total lineal feet = ____________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #2 — SUBTRACT WHOLE NUMBERS

NAME ______________________________ SCORE ____________

Addition is the first fundamental operation in mathematics. Subtraction, the opposite of addition, is the process of finding the difference between two numbers. It is the second fundamental operation. You can check the accuracy of the answer obtained in a subtraction problem by simply adding the difference to the subtracted number. The sum of these two numbers will equal the original number if the answer is correct.

EXAMPLES:

$$\begin{array}{rl} 12 & \text{Original Number} \\ -\ 7 & \text{Subtracted Number} \\ \hline +\ 5 & \text{Answer (Difference)} \\ \hline 12 & \text{Check Answer} \\ & \text{(Same as original number)} \end{array} \qquad \begin{array}{rl} 57 & \text{Original Number} \\ -\ 35 & \text{Subtracted Number} \\ \hline +\ 22 & \text{Answer (Difference)} \\ \hline 57 & \text{Check Answer} \end{array}$$

PART I

Solve each of the following subtraction problems. Check your answers by adding the difference to the subtracted number. Refer to Information Sheet, Section V, if necessary, and show your work.

A. $\begin{array}{r} 9 \\ -\ 5 \\ \hline \end{array}$ B. $\begin{array}{r} 15 \\ -\ 8 \\ \hline \end{array}$ C. $\begin{array}{r} 75 \\ -\ 22 \\ \hline \end{array}$ D. $\begin{array}{r} 453 \\ -\ 47 \\ \hline \end{array}$ E. $\begin{array}{r} 742 \\ -\ 318 \\ \hline \end{array}$

F. $\begin{array}{r} 981 \\ -\ 698 \\ \hline \end{array}$ G. $\begin{array}{r} 1420 \\ -\ 245 \\ \hline \end{array}$ H. $\begin{array}{r} 3459 \\ -\ 1649 \\ \hline \end{array}$ I. $\begin{array}{r} 55722 \\ -\ 4272 \\ \hline \end{array}$ J. $\begin{array}{r} 98679 \\ -\ 8957 \\ \hline \end{array}$

PART II

A. If a sidewalk form takes 172 two-by-fours and you have 46, how many more two-by-fours would you need for the form job?

Number of two-by-fours = ____________

ASSIGNMENT SHEET #2

B. If you have 542 lineal feet of plastic pipe and it takes 1702 lineal feet of plastic pipe to complete the job, how many more lineal feet will you need?

Number of lineal feet needed = ____________

C. You have 6520 square feet of roofing to replace on a remodeling job. You have 470 square feet credited to your account from another job and 1640 square feet credited to your account from another job. How many more square feet will you need to pay for to complete the job?

Number of square feet needed = ____________

D. An electrician ordered 48,000 outlet boxes. Of these, she used 4,850 on one job, 12,720 on another job, and 16,285 on another job. How many outlet boxes did she have left?

Number of outlet boxes left = ____________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #3 — MULTIPLY WHOLE NUMBERS

NAME ______________________________ SCORE ______________

Multiplication is the third basic operation in mathematics. It is a shortcut method of adding. For example, if you correctly add twelve 12s, the result will be 144, the same as 12 multiplied by 12. Some multiplication problems involve carrying. You may write down the carried digits, or simply remember them. Use the method that works best for you.

When multiplying by numbers that contain two or more digits, you must be careful to align the partial products properly. Write the right-hand digit of each partial product directly below the multiplying digit. This causes the partial products to be properly aligned so that tens will be added to tens, hundreds to hundreds, and so on.

EXAMPLES:

$$\begin{array}{r} 8 \\ \times\ 7 \\ \hline 56 \end{array} \qquad \begin{array}{rl} 1 & \leftarrow \text{Carried Digit} \\ 53 & \\ \times\ \ 4 & \\ \hline 212 & \end{array} \qquad \begin{array}{rl} 11\ & \leftarrow \text{Carried Digits} \\ 756 & \\ \times\ 312 & \\ \hline 1512 & \leftarrow \text{First Partial Product} \\ 756\ \ & \leftarrow \text{Second Partial Product} \\ 2268\ \ \ \ & \leftarrow \text{Third Partial Product} \\ \hline 235872 & \leftarrow \text{Product} \end{array}$$

PART I

Solve each of the following multiplication problems. Refer to Information Sheet, Section VI, if necessary, and show your work.

A. $\begin{array}{r} 6 \\ \times\ 7 \\ \hline \end{array}$ B. $\begin{array}{r} 9 \\ \times\ 8 \\ \hline \end{array}$ C. $\begin{array}{r} 54 \\ \times\ 6 \\ \hline \end{array}$ D. $\begin{array}{r} 721 \\ \times\ 4 \\ \hline \end{array}$ E. $\begin{array}{r} 1682 \\ \times\ 5 \\ \hline \end{array}$

F. $\begin{array}{r} 78 \\ \times\ 26 \\ \hline \end{array}$ G. $\begin{array}{r} 453 \\ \times\ 47 \\ \hline \end{array}$ H. $\begin{array}{r} 314 \\ \times\ 527 \\ \hline \end{array}$ I. $\begin{array}{r} 2143 \\ \times\ 235 \\ \hline \end{array}$ J. $\begin{array}{r} 4123 \\ \times\ 1324 \\ \hline \end{array}$

ASSIGNMENT SHEET #3

PART II

A. If one load of sheet metal weighs 9769 pounds, how much would 7 loads weigh?

Weight = ______________

B. If a concrete mason can install an average of 170 square feet of topping per hour, how many square feet can she install in 48 hours?

Number of square feet = ______________

C. Six brick masons lay an average of 950 square feet of brick per person per day. What will be each mason's average for 3 days' work?

Average square feet = ______________

D. Figure the amount of time worked in 4 weeks by 12 ironworkers who work 30 hours each week.

Hours worked = ______________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #4 — DIVIDE WHOLE NUMBERS

NAME ______________________________ SCORE ______________

Construction workers use division in many aspects of their work. Construction features are often installed in sets of the same size units. By dividing the space allowed for such structures by the size of the individual units, the construction worker can determine the number of units required. Division is also used to compute costs and expenses and in making estimates.

Division is the fourth and last basic operation in mathematics. Multiplication puts together—division takes apart. Division is the reverse of multiplication. *Long division* is the name used for division by numbers that cannot readily be used as simple dividers. Division answers are checked by multiplying the divisor by the answer and adding the remainder.

EXAMPLES:

$$\begin{array}{r} \text{Answer} \\ \text{Divisor}\overline{)\text{Original Number}} \end{array} \qquad \begin{array}{r} 324 \\ 3\overline{)972} \\ \underline{9} \\ 7 \\ \underline{6} \\ 12 \\ \underline{12} \end{array}$$

$$\begin{array}{rl} 0111 & \text{Answer} \\ 51\overline{)5678} & \\ \underline{51} & \\ 57 & \\ \underline{51} & \\ 68 & \\ \underline{51} & \\ 17 & \text{Remainder} \end{array} \qquad \text{Check:} \quad \begin{array}{rl} 111 & \text{Answer} \\ \underline{\times\ 51} & \text{Divisor} \\ 111 & \\ \underline{555} & \\ 5661 & \\ \underline{+\ 17} & \text{Remainder} \\ 5678 & \text{Original Number} \end{array}$$

PART I

Solve each of the following division problems. Check your answers by multiplying the divisor by the original number. Refer to Information Sheet, Section VII, if necessary, and show your work.

A. $2\overline{)8}$ B. $6\overline{)48}$ C. $9\overline{)819}$ D. $4\overline{)1248}$ E. $13\overline{)39}$

ASSIGNMENT SHEET #4

F. $66\overline{)198}$ G. $84\overline{)5212}$ H. $124\overline{)345}$ I. $464\overline{)829}$ J. $746\overline{)2872}$

PART II

A. Four carpenters working together laid 8280 square feet of flooring in one day. What was the average number of square feet laid by each carpenter that day?

Average square feet = ____________________

B. A home buyer has requested that one wall of a dining room be done in 1-foot-by-4-foot windows. How many windows can be installed if the wall is 108 inches long and the windows, with connecting mulls, are 13 inches wide? How much space will be left?

Number of windows installed = ____________________

Amount of space left = ____________________

C. A contractor built 26 houses. The project required 25,350 square feet of colored concrete. How much colored concrete was required on the average per house?

Square feet of colored concrete = ____________________

D. A sheet of 4-foot-by-8-foot plywood is 32 square feet. How many sheets of plywood would be required to deck a roof area of 2176 square feet if no allowance is made for waste?

Number of sheets of plywood = ____________________

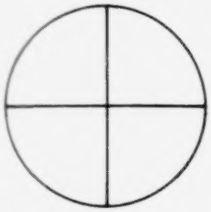
BASIC MATH
UNIT II

ASSIGNMENT SHEET #5 — WORK WITH FRACTIONS

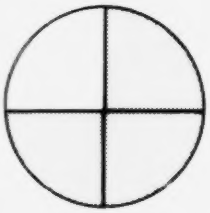
NAME ______________________________ SCORE ____________

Fractions are essential to the construction trade. Not only does the construction worker frequently use fractions for measurements, but much of the material used in the trade is sized by fractional units. Expansion-joint material comes in sizes 1/2- and 5/8-inch thick. Even lumber that is referred to in even numbers is actually measured in fractional inches. For example, a two-by-four board is actually 1 1/2 inches × 3 1/2 inches. This frequent use of fractions in the trade makes it necessary for the construction worker to understand thoroughly how to work with fractions.

When something is divided into parts that are all the same size, or of equal size, it is divided into fractional parts. For example, the circle below is divided into four fractional parts.



To talk about fractional parts, you use fractions. For example, one of the four parts of the circle below is unshaded, or 1/4 of the circle is unshaded; three of the four parts of the circle are shaded, or 3/4 of the circle is shaded.



In the fraction 3/4, the 4 is called the *denominator*. It shows the number of equal parts into which the circle is divided. The 3 is called the *numerator*. It shows the number of parts that are used.

PART I

A. Identify the numerator and denominator of each of the following fractions by filling in the blanks. Refer to Information Sheet, Section VIII, if necessary.

1. In the fraction 5/8, the numerator is ______ and the denominator is ______.

ASSIGNMENT SHEET #5

2. In the fraction 7/16, 7 is the ______________________________ and 16 is the ______________________________.

3. In the fraction 1/4, what is the numerator? ________ denominator? ________

B. Write the fractions that fit the following statements.

______________________ 1. A fraction with a denominator of 16 and a numerator of 10.

______________________ 2. A fraction with a numerator of 16 and a denominator of 32.

C. A concrete mason divides a sidewalk into 8 equal sections and then takes out 1 of the 8 sections.

______________________ 1. Which number represents the numerator of the fraction removed?

______________________ 2. Which number represents the denominator?

______________________ 3. What fractional part of the sidewalk did the concrete mason take out?

PART II

A. Match the shadeded portions of the following figures to the fractions they represent. Write the correct letters in the blanks.

______ 1. 4/8

______ 2. 2/2

______ 3. 6/16

______ 4. 3/8

______ 5. 5/8

______ 6. 1/2

______ 7. 7/16

______ 8. 3/4

______ 9. 1/4

______ 10. 1/8

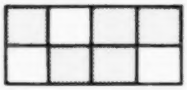
______ 11. 7/8

______ 12. 2/4

______ 13. 2/8

______ 14. 13/16

______ 15. 6/8

a.


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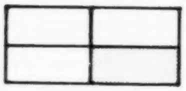

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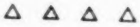

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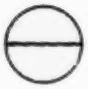

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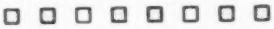

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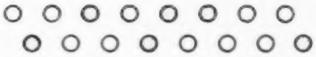

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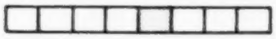

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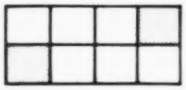

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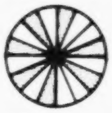

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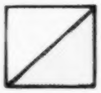

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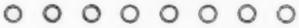

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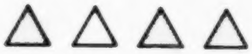

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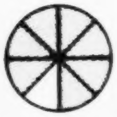

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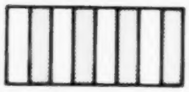

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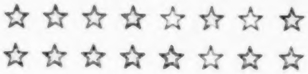


ASSIGNMENT SHEET #5

B. Draw a figure shaded to represent each of the following fractions.

EXAMPLE: $^3/_4$

1. $^1/_2$

6. $^5/_{16}$

2. $^3/_4$

7. $^2/_8$

3. $^5/_8$

8. $^3/_{16}$

4. $^1/_4$

9. $^3/_8$

5. $^7/_8$

10. $^{13}/_{16}$

BASIC MATH
UNIT II

ASSIGNMENT SHEET #6 — REDUCE FRACTIONS TO LOWEST TERMS

NAME ______________________________ SCORE ______________

Fractions are "reduced" to their lowest terms so that they are more readily understood or recognized. For example, $^{1}/_{2}$ is more easily recognized than $^{16}/_{32}$.

To reduce a fraction to its lowest terms, divide the numerator and the denominator by the largest whole number that will go into both evenly.

EXAMPLES: $\frac{9}{12} = \frac{9 \div 3}{12 \div 3} = \frac{3}{4}$ $\qquad \frac{12}{32} = \frac{12 \div 4}{32 \div 4} = \frac{3}{8}$

Reduce the following fractions to their lowest terms. Refer to Information Sheet, Section IX, if necessary.

A. $^{4}/_{8}$ = ______

B. $^{8}/_{16}$ = ______

C. $^{2}/_{2}$ = ______

D. $^{4}/_{16}$ = ______

E. $^{12}/_{48}$ = ______

F. $^{9}/_{24}$ = ______

G. $^{16}/_{32}$ = ______

H. $^{2}/_{4}$ = ______

I. $^{9}/_{12}$ = ______

J. $^{50}/_{100}$ = ______

BASIC MATH
UNIT II

ASSIGNMENT SHEET #7 — CONVERT UNLIKE FRACTIONS TO LIKE FRACTIONS

NAME ______________________________ SCORE ____________

Fractions must have common denominators if they are to be added or subtracted. Fractions that have the same denominator are said to have a *common* denominator and to be *like fractions.* The easiest way to find a common denominator for two fractions is to multiply the numerator and the denominator of each fraction by the denominator of the other fraction.

EXAMPLE: Find a common denominator for the fractions $1/4$ and $3/16$ and convert to like fractions.

$$\frac{1}{4} = \frac{1 \times 16}{4 \times 16} = \frac{16}{64} \quad \text{and} \quad \frac{3}{16} = \frac{3 \times 4}{16 \times 4} = \frac{12}{64}$$

Because a common denominator is any denominator into which the denominators of both fractions will divide evenly, two fractions can have a number of common denominators. Although it is easy to find common denominators by multiplying the denominators by one another, this often leads to numbers that are awkward to work with. For that reason, fractions are usually added after the *lowest* common denominator has been found.

EXAMPLE: Common denominators for the fractions $1/4$ and $3/16$ include 16, 32, 48, 64, 80, and many more.

$4/16$ and $3/16$
$8/32$ and $6/32$
$12/48$ and $9/48$
$16/64$ and $12/64$
$20/80$ and $15/80$

The lowest common denominator is the lowest one into which the others can be divided evenly. To find the lowest common denominator, find any common denominator by the method shown above, and reduce it.

EXAMPLE: Convert the fractions $6/15$ and $3/10$ to like fractions with the lowest common denominator.

$$\frac{6}{15} = \frac{6 \times 10}{15 \times 10} = \frac{60}{150} = \frac{12}{30} \quad \text{and} \quad \frac{3}{10} = \frac{3 \times 15}{10 \times 15} = \frac{45}{150} = \frac{9}{30}$$

ASSIGNMENT SHEET #7

To change a fraction to its equivalent with a higher denominator, multiply the denominator of the given fraction by a number that will give the desired denominator; then multiply the numerator of the fraction by the same multiplier.

EXAMPLE: You want to find out how many eighths there are in $1/2$.

$\frac{1}{2 \times 4} = \frac{?}{8}$ Multiply the denominator by 4 to give you the eighths denominator.

$\frac{1}{2} = \frac{?}{8}$ $\frac{1 \times 4}{2 \times 4} = \frac{4}{8}$ $\frac{1}{2} = \frac{4}{8}$

To change a fraction to its equivalent with a lower denominator, divide both the denominator and the numerator by the same number.

EXAMPLE: You want to find out how many fourths there are in $12/16$.

$\frac{12}{16} = \frac{?}{4}$ $\frac{12 \div 4}{16 \div 4} = \frac{3}{4}$ $\frac{12}{16} = \frac{3}{4}$

PART I

Convert each of the fractions below to equivalent fractions for the denominator given.

A. $\frac{1}{2} = \frac{\ }{8}$

B. $\frac{1}{4} = \frac{\ }{32}$

C. $\frac{12}{16} = \frac{\ }{4}$

D. $\frac{10}{32} = \frac{\ }{16}$

E. $\frac{6}{8} = \frac{\ }{4}$

F. $\frac{5}{8} = \frac{\ }{32}$

G. $\frac{9}{16} = \frac{\ }{32}$

H. $\frac{18}{32} = \frac{\ }{16}$

I. $\frac{3}{4} = \frac{\ }{8}$

J. $\frac{7}{8} = \frac{\ }{32}$

K. $\frac{24}{32} = \frac{\ }{4}$

L. $\frac{28}{64} = \frac{\ }{16}$

PART II

Multiply the denominators in the following sets of fractions to convert them to like fractions.

A. $\frac{3}{8}$ and $\frac{1}{2}$ = ____________ and ____________

B. $\frac{3}{4}$ and $\frac{9}{32}$ = ____________ and ____________

ASSIGNMENT SHEET #7

C. $\frac{1}{16}$ and $\frac{5}{8}$ = ___________ and ___________

D. $\frac{1}{2}$ and $\frac{7}{16}$ = ___________ and ___________

E. $\frac{3}{4}$ and $\frac{9}{16}$ and $\frac{7}{32}$ = ___________ and ___________ and ___________

PART III

Change the following sets of fractions to like fractions with the *lowest* common denominators.

A. $\frac{3}{10}$ and $\frac{1}{4}$ = ___________ and ___________

B. $\frac{2}{3}$ and $\frac{3}{16}$ = ___________ and ___________

C. $\frac{3}{4}$ and $\frac{9}{32}$ = ___________ and ___________

D. $\frac{1}{2}$ and $\frac{7}{16}$ = ___________ and ___________

E. $\frac{3}{4}$ and $\frac{5}{8}$ and $\frac{7}{10}$ = ___________ and ___________ and ___________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #8 — CONVERT FRACTIONS AND MIXED NUMBERS

NAME ______________________________ SCORE ______________

A fraction such as $\frac{3}{4}$ is called a *proper fraction* because its numerator (top number) is smaller than its denominator (bottom number). Some examples of proper fractions are $\frac{2}{3}$, $\frac{1}{5}$, and $\frac{7}{8}$.

When the numerator of a fraction is the same, or larger, than the denominator, the fraction is called an *improper fraction.* Some examples of improper fractions are $\frac{4}{4}$, $\frac{5}{3}$, $\frac{9}{4}$, and $\frac{10}{8}$.

Numbers such as $2\frac{1}{2}$, $5\frac{3}{4}$, and $6\frac{2}{5}$ are called *mixed numbers.* They are made up of a whole number and a proper fraction.

Complete the following exercises. Refer to Information Sheet, Sections VIII, X, and XI, if necessary.

PART I

A. Distinguish among the following fractions by writing a "P" in the blanks before a proper fraction, an "I" before an improper fraction, and an "M" in the blanks before a mixed number.

_____ 1. $\frac{1}{2}$

_____ 2. $3\frac{7}{8}$

_____ 3. $\frac{16}{2}$

_____ 4. $3\frac{1}{8}$

_____ 5. $\frac{1}{4}$

_____ 6. $\frac{1}{1}$

_____ 7. $\frac{7}{2}$

_____ 8. $8\frac{1}{2}$

_____ 9. $\frac{4}{4}$

_____10. $9\frac{3}{16}$

_____11. $5\frac{1}{2}$

_____12. $\frac{9}{8}$

_____13. $\frac{9}{4}$

_____14. $\frac{1}{8}$

_____15. $16\frac{3}{4}$

B. Write a numerator over each of the following denominators to make proper fractions.

1. $\frac{\_}{8}$

2. $\frac{\_}{4}$

3. $\frac{\_\_}{32}$

4. $\frac{\_}{2}$

5. $\frac{\_\_}{16}$

ASSIGNMENT SHEET #8

C. Write a numerator over each of the following denominators to make improper fractions.

1. $\frac{}{2}$

2. $\frac{}{4}$

3. $\frac{}{16}$

4. $\frac{}{8}$

5. $\frac{}{4}$

PART II

A. Convert each of the following mixed numbers to improper fractions. Reduce to lowest terms when possible.

1. $3^{1}/_{4}$ = ______
2. $4^{1}/_{2}$ = ______
3. $7^{3}/_{4}$ = ______
4. $8^{1}/_{2}$ = ______
5. $6^{1}/_{8}$ = ______
6. $5^{2}/_{4}$ = ______
7. $4^{1}/_{4}$ = ______
8. $9^{1}/_{2}$ = ______
9. $9^{1}/_{4}$ = ______
10. $16^{1}/_{2}$ = ______

B. Convert each of the following improper fractions to mixed numbers. Reduce to lowest terms when possible.

1. ${}^{7}/_{4}$ = ______
2. ${}^{9}/_{2}$ = ______
3. ${}^{6}/_{4}$ = ______
4. ${}^{15}/_{8}$ = ______
5. ${}^{19}/_{16}$ = ______
6. ${}^{11}/_{8}$ = ______
7. ${}^{75}/_{32}$ = ______
8. ${}^{5}/_{2}$ = ______
9. ${}^{15}/_{4}$ = ______
10. ${}^{33}/_{16}$ = ______

BASIC MATH
UNIT II

ASSIGNMENT SHEET #9 — ADD FRACTIONS

NAME ______________________________ SCORE ____________

One of the most common calculations done by construction workers is the addition of fractions. For example, boards are seldom cut to lengths of even feet or inches. Often the length of a cut can only be determined by adding several dimensions, any of which may include a fraction. For accurate construction, the lengths must be figured correctly.

To add common fractions, change to equivalent fractions with lowest common denominators. Add the new numerators and place this sum over the lowest common denominator. If the result is an improper fraction, change it to a mixed number and reduce to lowest terms.

EXAMPLE: $\frac{2}{3} + \frac{3}{4} = \frac{8}{12} + \frac{9}{12} = \frac{17}{12} = 1\frac{5}{12}$

Find common denominators and add the following fractions. Reduce to lowest terms. Refer to Information Sheet, Section XII, if necessary.

A. $\frac{1}{4} + \frac{2}{8} =$ __________

B. $\frac{4}{16} + \frac{3}{4} =$ __________

C. $\frac{5}{8} + \frac{3}{32} =$ __________

D. $\frac{9}{16} + \frac{5}{8} =$ __________

E. $\frac{3}{4} + \frac{5}{32} =$ __________

F. $\frac{7}{8} + \frac{5}{16} =$ __________

G. $\frac{9}{16} + \frac{3}{4} =$ __________

H. $\frac{4}{4} + \frac{25}{32} =$ __________

ASSIGNMENT SHEET #9

I. An epoxy resin for a special floor slab requires mixing a base liquid and a hardener. How many gallons of epoxy will be produced if you must mix 1 pint of hardener with 2 quarts of base?

(NOTE: There are 8 pints in a gallon. There are 4 quarts in a gallon.)

Gallons of epoxy = ____________________

J. A contractor puts both fiberboard and foil-backed styrofoam insulation on the exterior walls of houses. How much does this increase the thickness of a wall if the actual thickness of the fiberboard is $\frac{7}{16}$ inch and the actual thickness of the insulation is $\frac{21}{32}$ inch?

Increase in thickness = ____________________

K. Composition shingles are sold by the "square" — that is, the shingles required to cover 100 square feet of roof. There are three bundles of shingles per square. How many squares of shingles are left if a contractor has five bundles of shingles left from one job and two bundles left from another?

Number of squares = ____________________

L. How high above the subflooring must a carpenter hang a door if the door must clear the carpeting by $\frac{1}{8}$ inch, the carpet pad is $\frac{1}{2}$ inch thick, and the carpet is $\frac{9}{16}$ inch thick?

Height above subflooring = ____________________

M. A carpenter needs a door jamb that will cover the end of a wall that has $\frac{3}{8}$ inch of paneling and $\frac{1}{2}$ inch of plasterboard on each side of a $3\frac{1}{2}$-inch wall stud. How wide must the jamb be?

Width of jamb = ____________________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #10 — SUBTRACT FRACTIONS

NAME ______________________________ SCORE ____________

Just as construction workers must frequently add fractions, they must also subtract fractions. Although the dimensions on a blueprint may look nice and even, the actual construction leads to many fractional measurements. For example, a blueprint may show that a door is 2′ – 4″ wide. However, the carpenter will leave a rough opening of approximately 2′ – 6½″ because the door frame will reduce the opening. Subtraction of fractions is helpful in figuring such reductions.

To subtract common fractions, change to equivalent fractions with common denominators. Find the difference between the numerators of the equivalent fractions. Place the difference over the common denominator and, if necessary, reduce the answer to lowest terms.

EXAMPLE: $\frac{2}{3} - \frac{1}{4}$ becomes $\frac{8}{12} - \frac{3}{12} = \frac{5}{12}$

Subtract each of the common fractions given below. Reduce to lowest terms. Refer to Information Sheet, Section XIII, if necessary.

A. $\frac{3}{4} - \frac{3}{16} =$ __________

B. $\frac{7}{8} - \frac{1}{4} =$ __________

C. $\frac{30}{32} - \frac{3}{4} =$ __________

D. $\frac{25}{32} - \frac{5}{8} =$ __________

E. $\frac{7}{8} - \frac{2}{16} =$ __________

F. $\frac{15}{16} - \frac{3}{8} =$ __________

G. $\frac{1}{2} - \frac{7}{16} =$ __________

H. $\frac{3}{4} - \frac{3}{8} =$ __________

I. $\frac{13}{16} - \frac{9}{32} =$ __________

J. $\frac{7}{8} - \frac{6}{16} =$ __________

ASSIGNMENT SHEET #10

K. The actual dimensions of a two-by-four board are 1½" × 3½". How much difference is there between the stated width and actual width of a two-by-four board?

Difference in width = ____________________

L. The directions for installing dowel rods state that the ironworker must first drill a hole 1/32 inch smaller than the diameter of the rod. What diameter hole must be drilled if the ironworker uses dowel rods with a 9/16-inch diameter?

Hole diameter = ____________________

M. What is the difference in diameter between ½-inch copper tubing and ⅝-inch copper tubing?

Difference in diameter = ____________________

N. A saw blade removes 1/64 inch of wood for each cut. A board 47⅝ inches long is cut in two. If one piece is 24½ inches long, how long is the other piece?

Length = ____________________

O. A 12-penny nail is 3¼ inches long, not counting the head. If a two-by-four board is actually 1½ inch thick, how much of the nail will extend beyond the board if you drive a 12-penny nail through a two-by-four board?

Length of extended part of nail = ____________________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #11 — MULTIPLY FRACTIONS

NAME ______________________________ SCORE ______________

Multiplying with fractions is often a shortcut for adding fractions; and because construction workers often add similar fractions, they can multiply to save time. For example, to figure five openings 23 3/4 inches that must be blocked out of a slab, it is much easier to multiply the width by the number of openings rather than to add 23 3/4 inches five times. A good construction worker quickly learns to appreciate the convenience of being able to multiply fractions when possible.

To multiply fractions, multiply the numerators and denominators separately. Write the product of the numerators over the product of the denominators and reduce to lowest terms.

EXAMPLE: $\frac{2}{3} \times \frac{3}{4}$ becomes $\frac{2 \times 3}{3 \times 4} = \frac{6}{12} = \frac{1}{2}$

Multiply the following fractions. Convert mixed fractions where needed and reduce answers to lowest terms. Refer to Information Sheet, Section XIV, if necessary.

A. $\frac{1}{2} \times \frac{3}{4} =$ ______

B. $\frac{3}{8} \times \frac{5}{16} =$ ______

C. $1\frac{1}{2} \times 2\frac{1}{4} =$ ______

D. $\frac{1}{2} \times 6\frac{1}{2} =$ ______

E. $\frac{7}{8} \times \frac{2}{3} =$ ______

F. $1\frac{1}{3} \times 2\frac{1}{4} \times \frac{1}{2} =$ ______

G. $\frac{1}{4} \times \frac{1}{3} \times \frac{1}{2} =$ ______

H. $2\frac{3}{4} \times 6\frac{1}{8} =$ ______

ASSIGNMENT SHEET #11

I. A pipe slopes in such a way that the pipe is $\frac{1}{4}$ foot higher for each horizontal foot along the base of the pipe. What is the total rise in feet if the pipe rises for a distance of $8\frac{1}{2}$ feet?

Total rise = ______________________

J. A certain adhesive requires mixing $\frac{3}{4}$ gallon base and $\frac{1}{4}$ gallon hardener to make a gallon of adhesive. How much base should a worker use if she needs to mix only $\frac{1}{3}$ gallon of adhesive?

Amount of base = ______________________

K. There are 296 drywall nails per pound. How many nails are there in $\frac{1}{4}$ pound?

Number of nails = ______________________

L. After completing an addition of houses, a contractor has $8\frac{2}{3}$ pounds of concrete coloring left in three different colors. If one-half of the coloring is brown, how many pounds of brown coloring are there?

Number of pounds of brown coloring = ______________________

M. A carpenter is installing a lockset in a $1\frac{3}{4}$-inch-thick door. He wants to drill a hole in the edge of the door for the strike, and he wants the strike centered on the edge. Where must the hole be drilled if the strike is centered half way across the $1\frac{3}{4}$-inch edge?

Hole location = ______________________ from each side of edge

BASIC MATH
UNIT II

ASSIGNMENT SHEET #12 — DIVIDE FRACTIONS

NAME ______________________________ SCORE ______________

Just as construction workers must be able to multiply fractions to save time, they must also be able to divide fractions. A good construction worker quickly learns to appreciate the convenience of being able to divide as well as multiply fractions when possible.

To divide fractions, invert the divisor and then multiply the numerators and denominators separately. Write the product of the numerators over the product of the denominators and reduce to lowest terms.

EXAMPLE: $\frac{3}{4} \div \frac{1}{8} = \frac{3}{4} \times \frac{8}{1} = \frac{3 \times 8}{4 \times 1} = \frac{24}{4} = 6$

Divide the following fractions. Convert mixed fractions where needed and reduce answers to lowest terms. Refer to Information Sheet, Section XV, if necessary.

A. $\frac{7}{8} \div \frac{3}{4} =$ ______

B. $\frac{3}{4} \div 2 =$ ______

C. $\frac{5}{6} \div \frac{4}{5} =$ ______

D. $3\frac{1}{2} \div \frac{3}{4} =$ ______

E. $\frac{9}{10} \div \frac{1}{3} =$ ______

F. $7\frac{1}{3} \div \frac{3}{5} =$ ______

G. $\frac{3}{8} \div \frac{1}{2} =$ ______

H. $8 \div \frac{3}{5} =$ ______

I. $12\frac{3}{8} \div 1\frac{1}{2} =$ ______

J. $2\frac{2}{3} \div \frac{1}{16} =$ ______

BASIC MATH
UNIT II

ASSIGNMENT SHEET #13 — ADD DECIMAL NUMBERS

NAME ____________________________________ SCORE ______________

As a consumer of raw materials, an insulation installer often needs to calculate the costs of insulation bats. Such costs are figured in dollars and cents. But cents are only decimal parts of a dollar, and every time a construction worker or anyone else totals the cost of a purchase, they are adding decimals.

You can add decimals just as you add whole numbers. You must be careful, though, to keep all decimal points aligned.

Add each column of numbers, carrying when necessary. Place a decimal point in the answer directly under the decimal points above. Refer to Information Sheet, Section XVII, if necessary.

EXAMPLES:

$$\begin{array}{r} 0.26 \\ +\ 0.168 \\ \hline 0.428 \end{array} \qquad \begin{array}{r} \$4.60 \\ +\ \ .40 \\ \hline \$5.00 \end{array}$$

A.
$$\begin{array}{r} 0.024 \\ +\ 0.165 \\ \hline \end{array}$$

B.
$$\begin{array}{r} 0.873 \\ +\ 0.199 \\ \hline \end{array}$$

C.
$$\begin{array}{r} \$4.60 \\ +\ \ 4.62 \\ \hline \end{array}$$

D.
$$\begin{array}{r} 0.0003 \\ +\ 0.0099 \\ \hline \end{array}$$

E.
$$\begin{array}{r} \$62.14 \\ +\ \ \ 8.87 \\ \hline \end{array}$$

F.
$$\begin{array}{r} \$34.87 \\ +\ \ 96.45 \\ \hline \end{array}$$

G.
$$\begin{array}{r} 195.7 \\ 83. \\ +\ \ \ 9.006 \\ \hline \end{array}$$

H.
$$\begin{array}{r} 0.0131 \\ 0.1640 \\ +\ 0.2229 \\ \hline \end{array}$$

I.
$$\begin{array}{r} 4.612 \\ 0.958 \\ +\ 0.885 \\ \hline \end{array}$$

J.
$$\begin{array}{r} 4937.23 \\ 4980.47 \\ 10234.97 \\ +\ \ 9872.21 \\ \hline \end{array}$$

K.
$$\begin{array}{r} 15.125 \\ 4.625 \\ 20.125 \\ +\ 16.125 \\ \hline \end{array}$$

L.
$$\begin{array}{r} 0.52802 \\ 0.34007 \\ 0.00321 \\ +\ 0.00009 \\ \hline \end{array}$$

ASSIGNMENT SHEET #13

M. A contractor bought some roofing materials and spent $141.72 for shingles, $16.81 for felt paper, and $6.27 for flashing. What was the total cost of the roofing materials?

Total cost = ____________________

N. An insulation installer worked four days for a certain contractor. She worked 6.8 hours Monday, 7.4 hours Tuesday, 9.3 hours Wednesday, and 4.4 hours Thursday. How many total hours did she work for the contractor?

Total hours worked = ____________________

O. How much was spent on tools if an electrician bought the tools below at the prices listed?

Electric grinder	$95.88
Hand level	$9.95
Piece of keel	39¢
Hacksaw	$6.49
Pliers	$10

Total cost = ____________________

P. For tax purposes, a welder must keep track of mileage driven in the line of work. During the past quarter, he drove 386.4 miles the first month, 519 miles the second month, and 461.2 miles the third month. What was his total mileage for the quarter?

Total mileage = ____________________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #14 — SUBTRACT DECIMAL NUMBERS

NAME ______________________________ SCORE ______________

Decimals are a part of our daily lives, not only in figuring money but also in calculating time, distance, area, and many other quantities. In the construction trades, decimals are becoming more common, especially with the increased use of metric measurements. Subtraction is one of the basic mathematical operations done with decimals in the trade.

Set up each of the following problems in column form. Subtract and check your work. Remember, when you subtract decimals, the decimal points must be aligned. Refer to Information Sheet, Section XVIII, if necessary.

A. 868.87 – 516.89 = ____________________

B. 567 – 19.856 = ____________________

C. 198 – 56.987 = ____________________

D. 567.94 – 59.78 = ____________________

E. $815.23 – $65.98 = ____________________

F. 5000 – 892.66 = ____________________

ASSIGNMENT SHEET #14

G. An ironworker keeps track of mileage driven on the job. At the beginning of the month, the vehicle odometer reads 29,268.4. At the end of the month, the odometer reads 29,872.1. How many miles were driven during the month?

Miles driven for month = ____________________

H. An HVAC contractor completed a remodeling project and computed her profit. She was paid $6500.00 for the project. How much profit did she make if her expenses were $4718.96?

Profit = ____________________

I. A sheet metal worker has been using 12-gauge and 14-gauge flashing. In order to determine what screws to use to install skylights, she must know the difference in thickness of the two gauges. What is the difference if 12-gauge is 0.0808 inch thick and 14-gauge is 0.0641 inch thick?

Difference in thickness = ____________________

J. A brick mason bought brick on sale. He had estimated the cost to be $1238.62 based on the regular price. How much did he save if the cost on sale was $1061.19?

Savings = ____________________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #15 — MULTIPLY DECIMAL NUMBERS

NAME ______________________________ SCORE ______________

Concrete masons, sheet metal workers, and welders work with many geometric shapes and are often required to calculate the area of such shapes. The formulas used in computing the areas of shapes often require multiplying by decimals, such as in using 3.14 to figure the area of a circle. Additionally, costs and earnings may be calculated by multiplying with decimals—an essential skill for any good construction worker.

Multiplication with decimals is similar to multiplication with whole numbers. However, with decimals you must take care in placing the decimal point correctly. The number of decimal places in an answer must equal the total number of decimal places in the numbers that you multiplied.

EXAMPLE:	16.11	2 Decimal Places
	× 2.2	1 Decimal Place
	3222	
	3222	
	35.442	3 Decimal Places in Answer

Set up each of the following problems in column form and multiply. Locate the decimal point in the answer. Refer to Information Sheet, Section XIX, if necessary.

A. 2.64 × 3.1 = ____________________

B. 120 × 0.33 = ____________________

ASSIGNMENT SHEET #15

C. 2.25 × 0.51 = ______________________

D. 35 × 8.5 = ______________________

E. 26.4 × 3.8 = ______________________

F. 7.02 × 0.92 = ______________________

G. A concrete saw is placed on sale for 25 percent off. How much is the price reduced if the regular price is $1349.80?

(NOTE: Twenty-five percent is the same as the decimal 0.25.)

Price reduction = ______________________

ASSIGNMENT SHEET #15

H. The average cost per square foot of houses in a certain area is $41.25. What would be the approximate cost of a 1500-square-foot house?

Approximate cost = ____________________

I. A building code specifies a maximum grade for driveways of 33.3 percent, which means that the maximum slope for a driveway 100 feet in length would be 33.3 feet. How much slope would be allowed for a lot 75 feet deep?

Slope = ____________________

J. A concrete mason buys 38 pairs of knee boards at a cost of $3.49 each pair. What is the total cost?

Total cost = ____________________

K. If the average weight of terrazzo is 2.5 pounds per square foot, what is the total weight of the terrazzo on a 831.75-square-foot area?

Total weight = ____________________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #16 — DIVIDE DECIMAL NUMBERS

NAME ________________________________ SCORE ______________

A construction worker will usually have to shop around to find the best buys in tools and materials. Price comparisons often become difficult because not all suppliers base their prices on the same unit. For example, one supplier may price expansion material by the sheet while another quotes costs as so much a square foot. Being able to divide decimal numbers will help a construction worker determine the best buys. Division with decimal numbers is also useful in figuring quantities of materials, weighing job opportunities, and in many other aspects of the trade.

Division with decimals is like division with whole numbers. However, before you begin to divide, you must decide where the decimal point should be placed in the number.

First study the divisor. If it has a decimal, move the decimal point to the right so that you change the decimal to a whole number. Then move the decimal point the same number of places to the right in the original number (number into which you are dividing).

EXAMPLE 1: Decimal point moved one place in both numbers.

```
.2.).4.              2.
                 2. )4.
                     4
                     0
```

EXAMPLE 2: Decimal point moved two places in both numbers.

```
.14.).14.028              1.002
                     14. )14.028
                          14
                           0 028
                               28
                                0
```

EXAMPLE 3: Decimal point moved one place in both numbers; note that a zero had to be added.

```
1.3.)26.0.                20.
                     13. )260.
                          26
                           00
```

EXAMPLE 4: No decimal point was moved to the right because 3 is already a whole number.

```
3 ).6                 .2
                    3 ).6
                       6
                       0
```

ASSIGNMENT SHEET #16

Divide numbers in the following problems. Show your work. Refer to Information Sheet, Section XX, if necessary, and check your answers.

A. 4.5 ÷ 0.5 = ______________________

B. 4.96 ÷ 0.4 = ______________________

C. 19.8 ÷ 0.6 = ______________________

D. 10.71 ÷ 0.07 = ______________________

E. 0.225 ÷ 0.15 = ______________________

F. 1.7608 ÷ 0.0062 = ______________________

G. 0.48 ÷ 0.6 = ______________________

ASSIGNMENT SHEET #16

H. 406 ÷ 0.029 = ____________________

I. What is the approximate cost per bag of cement if the cost of twelve bags is $103.68?

Approximate cost = ____________________

J. How many hours did a brick mason work if she was paid a total of $681.75 at the rate of $22.50 per hour?

Total hours = ____________________

K. How many lots can be platted on a 21.12-acre addition if the average lot is 0.66 acres?

Number of lots = ____________________

L. A concrete mason spent $172.80 for aluminum straightedges. What was the cost per straightedge if he bought eight straightedges?

Cost per straightedge = ____________________

M. If it takes a roofer 12.6 hours to lay a 1680-square-foot roof, how long does it take to lay 100 square feet of roofing material?

Length of time = ____________________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #17 — CONVERT FRACTIONS AND PERCENTAGES

NAME ______________________________ SCORE ______________

In construction work, percentage is often useful. *Percent* means "per hundredths." Five percent means five one-hundredths and may be written three ways: $^{5}/_{100}$, 0.05, and 5%. All have the *same* mathematical value.

Complete the following exercises. Refer to Information Sheet, Sections XXI through XXIII, if necessary.

PART I

A. Express each of the following fractions as a decimal.

1. $^{1}/_{8}$ = ____________
2. $^{1}/_{2}$ = ____________
3. $^{5}/_{8}$ = ____________
4. $^{3}/_{32}$ = ____________
5. $^{9}/_{16}$ = ____________

B. Express each of the following fractions as a percentage.

1. $^{1}/_{4}$ = ____________
2. $^{7}/_{10}$ = ____________
3. $^{2}/_{2}$ = ____________
4. $^{7}/_{8}$ = ____________
5. $^{1}/_{3}$ = ____________

ASSIGNMENT SHEET #17

PART II

Fractions having denominators of ten, or one of the powers of ten (place values), are easily written as decimal numbers. Simply allow as many places to the right of the decimal point as there are zeros in the denominator.

EXAMPLES: $1^{5}/_{10} = 1.5$ tenths

$1^{25}/_{100} = 1.25$ hundredths

$1^{125}/_{1000} = 1.125$ thousandths

A. Match the decimal numbers on the right to their correct equivalent fractions. Write the correct letters in the blanks.

_____ 1. $^{87}/_{1000}$

_____ 2. $7\,^{83}/_{1000}$

_____ 3. $5\,^{6}/_{1000}$

_____ 4. $78\,^{3}/_{10}$

_____ 5. $^{783}/_{1000}$

a. 7.083

b. 5.006

c. 78.3

d. 0.087

e. 0.783

B. Write decimal equivalents for each of the following fractions.

1. $63\,^{9}/_{10}$ = ____________________
2. $5\,^{93}/_{1000}$ = ____________________
3. $3\,^{825}/_{1000}$ = ____________________
4. $38\,^{95}/_{1000}$ = ____________________
5. $402\,^{3}/_{10}$ = ____________________

PART III

A. Express each of the following percentages as a fraction. Reduce to lowest terms.

1. 50% = ____________________
2. $33^{1}/_{3}$% = ____________________
3. 28% = ____________________
4. 21% = ____________________
5. $66\,^{2}/_{3}$% = ____________________

ASSIGNMENT SHEET #17

B. Express each of the following percentages as a decimal.

1. 47% = ____________________________
2. 15% = ____________________________
3. 33.3% = __________________________
4. 62% = ____________________________
5. 75% = ____________________________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #18 — SOLVE PERCENTAGE PROBLEMS

NAME ______________________________ SCORE ____________

In the plumbing field, you will frequently come across percentages. Interest rates, pricing discounts, waste allowances, the rise or decline of housing starts, and many other factors that affect the industry are stated as percentages. To make the most of your career in this field, you must understand what percentages mean and how they are used.

Solve the following percentage problems. Refer to Information Sheet, Section XXIV, if necessary.

PART I

A. What does it mean to say 100 percent of the work is completed? ____________

____

B. There are usually 100 tools in the tool shed. Fourteen of them are missing. What percent of the tools are missing? ______________________________

C. If 14 of the tools are missing in the above problem, how many are present? ________

What percent are present? ______________________________

D. There are 100 stakes in a stack. Twenty-five stakes are what percent of the stakes in the stack? ______________________________

Five stakes are what percent of the stakes in the stack? ____________

ASSIGNMENT SHEET #18

E. There are 100 jobs on the agenda. Ninety-four have been completed. What percent of the jobs have been completed? ______________________________

F. If 94 of the jobs in the above problem have been completed, how many have not been?

____

What percent have not been completed? ______________________________

G. If 11 percent of the students in a school are absent, what percent are present? ______

H. If 6 percent of the hand saws that a store had in stock were not sold, what percent were sold? ______________________________

I. If 60 percent of the brick masons in town had cards, what percent did not have cards?

____

J. Bill has a set of pipe tools. Ten percent of his tools are a year old, and 40 percent are over a year old. What percent are less than a year old? ______________________________

ASSIGNMENT SHEET #18

PART II

Solve each of the following percentage problems.

A. 3% of 72 is what number? ___________

B. 5% of 18 is what number? ___________

C. What number is 33⅓% of 96? ___________

D. 40% of 125 is what number? ___________

E. 68% of 63.5 is what number? ___________

F. What number is 12½% of 140.8? ___________

G. What number is 1% of 103? ___________

H. What number is 37½% of 152? ___________

I. 50% of 32.8 is what number? ___________

J. 7% of 163 is what number? ___________

ASSIGNMENT SHEET #18

PART III

Solve the following percentage word problems. Show your work.

A. There are 20 students in a class. Sixty percent of the students are boys.

How many are boys? ___________

B. One day 5 percent of the 20 drywall installers in Mr. Moore's group made perfect time completing a job. How many drywall installers made perfect time? ___________

C. Contractor McGill bought a new compressor—regularly selling for $120—at a sale and saved 20 percent. How much money did he save? ___________

D. The number of welders at the meeting this week was 75 percent of what it was last week. Last week there were 800 welders at the meeting. How many welders were at the meeting this week? ___________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #19 — CALCULATE AREA

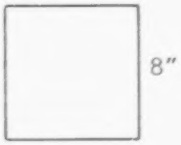
NAME ______________________________ SCORE ______________

One of the most common mathematical operations in estimating concrete materials is the calculation of area. You must figure area for floor slabs, walls, steps, sidewalks, driveways, parking lots, curbs, curbs and gutters, and many other areas of construction. In fact, the basic pricing unit in the industry is figured on the area of a structure. Therefore, to understand the costs of materials and construction, you must learn to calculate area.

Calculate area for the following problems. Refer to Information Sheet, Section XXVIII, if necessary.

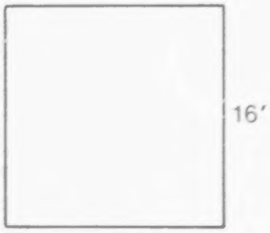
A. Calculate the area for each of the following squares.

1.



A = ______________________________

2.



A = ______________________________

3. Square = 15 feet

A = ______________________________

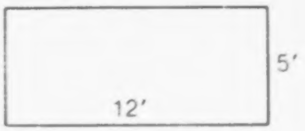
4. Square = 36 yards

A = ______________________________

ASSIGNMENT SHEET #19

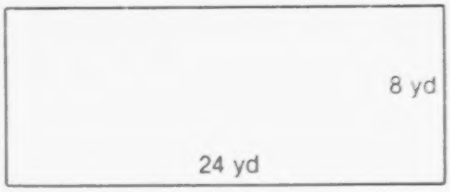
B. Calculate area for each of the following rectangles.

1.



A = ______________________________

2.



A = ______________________________

3. L = 17″; W = 31″

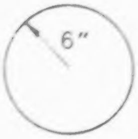
A = ______________________________

4. L = 16′; W = 62′

A = ______________________________

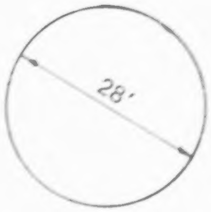
C. Calculate area for each of the following circles. (Use $\pi = 3.14$.)

1.



A = ______________________________

2.



A = ______________________________

ASSIGNMENT SHEET #19

3. Radius = 16′

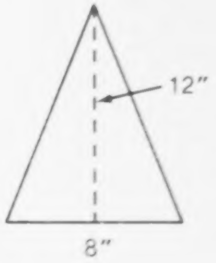
4. Diameter = 25 yards

A = ______________________

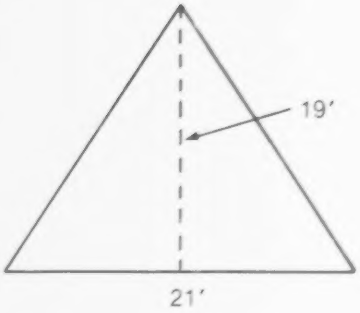
A = ______________________

D. Calculate area for each of the following triangles.

1.



2.



A = ______________________

A = ______________________

3. b = 13″; h = 3″

4. b = 24 yards; h = 15 yards

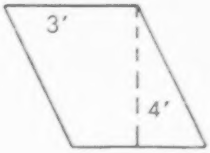
A = ______________________

A = ______________________

ASSIGNMENT SHEET #19

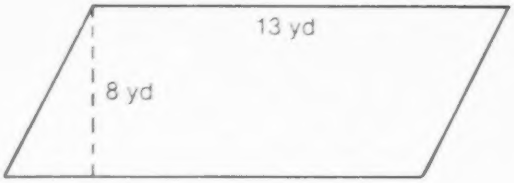
E. Calculate area for each of the following parallelograms.

1.



A = ______________________

2.



A = ______________________

3. b = 16″; h = 16″

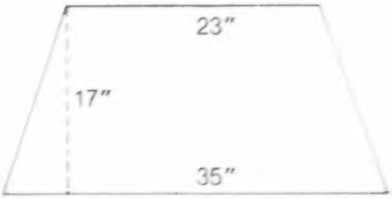
A = ______________________

4. b = 27 yards; h = 9 yards

A = ______________________

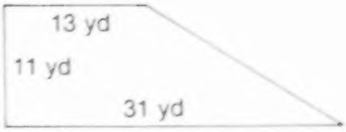
F. Calculate area for each of the following trapezoids.

1.



A = ______________________

2.


13 yd
11 yd
31 yd

A = ______________________

ASSIGNMENT SHEET #19

3. $H = 12'$; $B_1 = 9'$; $B_2 = 19'$

4. $H = 17$ yards; $B_1 = 39$ yards; $B_2 = 51$ yards

A = ______________________________

A = ______________________________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #20 — CALCULATE VOLUME

NAME ______________________________ SCORE ______________

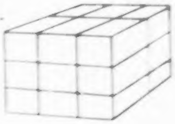
Construction workers should be familiar with volumetric measurements in order to make estimates and to use materials wisely. One of the most common uses of cubic volume measurements is in estimating concrete. Volumetric measurements can be used to estimate concrete for walls, steps, floor slabs; and they are also used by other crafts and other construction-related systems. A good construction worker must be familiar with how volume is determined.

PART I

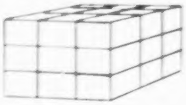
Record the dimensions and volume for the figures below this chart. Remember that volume is the number of cubic units. Refer to Information Sheet, Section XXIX, if necessary.

	Height = H	Width = W	Length = L	Volume = V
A.				
B.				
C.				
D.				
E.				
F.				
G.				
H.				
I.				
J.				

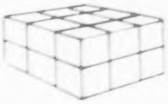
A.



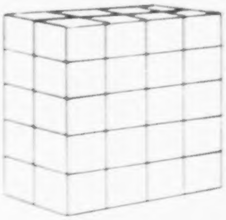
B.



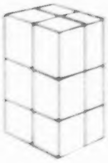
C.



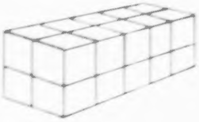
D.



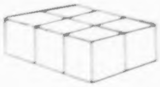
E.



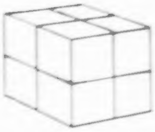
F.



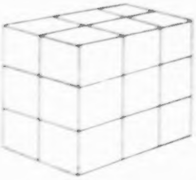
G.



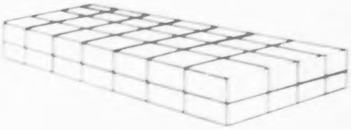
H.



I.



J.



ASSIGNMENT SHEET #20

PART II

Answer the following questions about the boxes illustrated.

____________________ A. How many cubes are there in Box #1?

____________________ B. How many cubes are still needed to fill the bottom layer of Box #1?

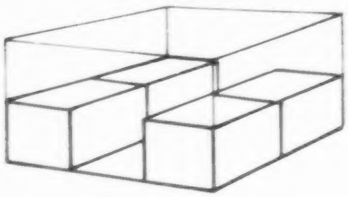
____________________ C. How many layers can Box #1 hold inside?

____________________ D. How many cubes are needed for the top layer in Box #1?

____________________ E. How many total cubes would there be if Box #1 were full?

____________________ F. What is the volume of Box #1?

Box #1

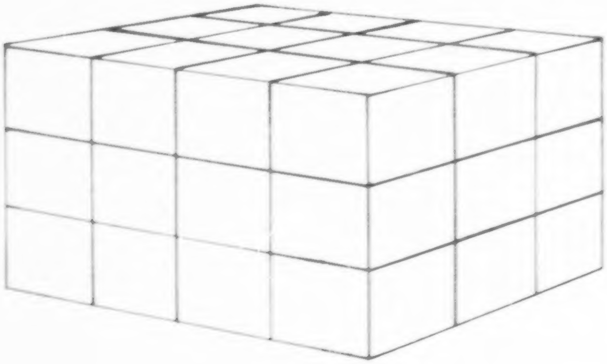


____________________ G. How many cubes are there in the bottom layer of Box #2?

____________________ H. How many layers are there in Box #2?

____________________ I. What way can volume be figured for Box #2 *without counting* each of the cubes?

Box #2



ASSIGNMENT SHEET #20

______________________ J. How many cubic inches in 1 cubic foot? (Think of stacking cubic inches in Box #3.)

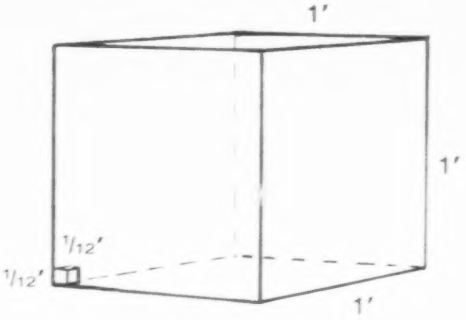
______________________ K. How many cubic inches would it take to fill one layer in Box #3?

______________________ L. How many cubic inches would it take to fill two layers in Box #3?

______________________ M. How many cubic inches would it take to fill three layers in Box #3?

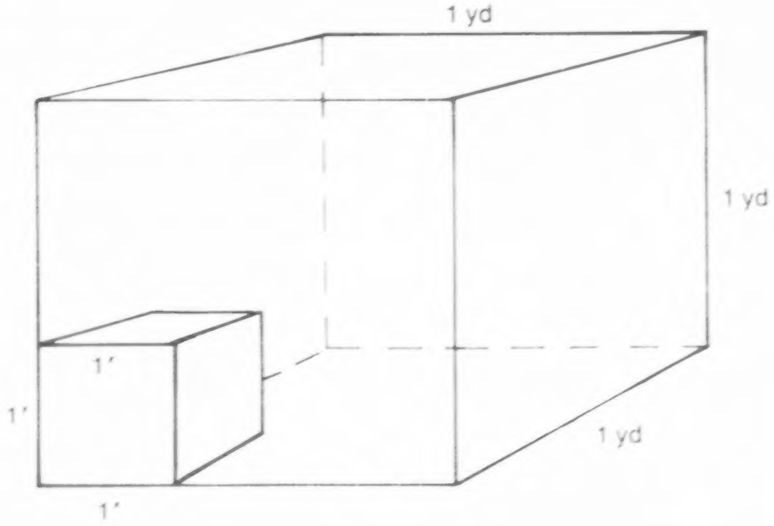
______________________ N. How many layers would it take to fill Box #3?

Box #3



______________________ O. How many cubic feet in 1 cubic yard? (Think of stacking cubic feet in Box #4.)

Box #4

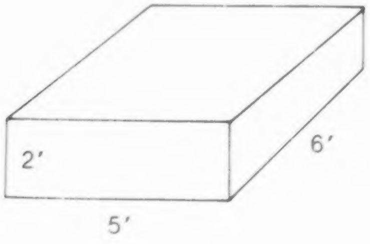


ASSIGNMENT SHEET #20

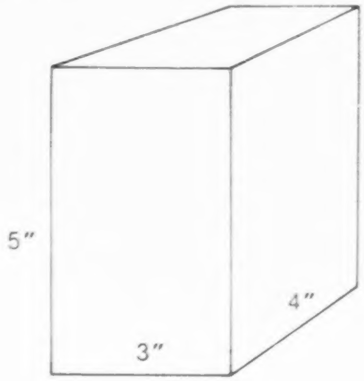
PART III

Use the formula V = LWH to calculate volume for the following figures.

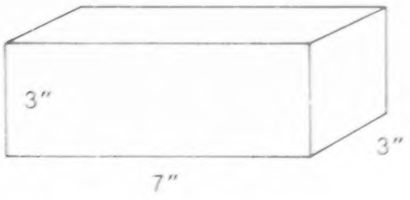
A. V = ______________________________



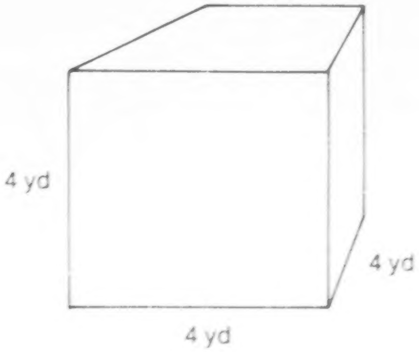
D. V = ______________________________



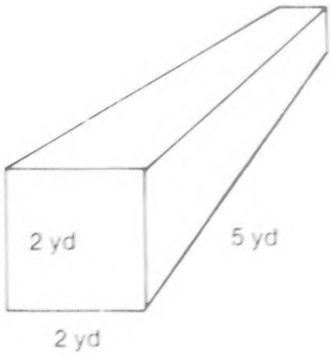
B. V = ______________________________



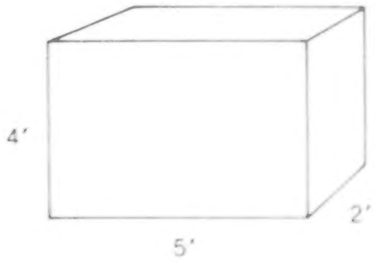
E. V = ______________________________



C. V = ______________________________



F. V = ______________________________



BASIC MATH
UNIT II

ASSIGNMENT SHEET #21 — ESTIMATE CUBIC YARDS

NAME ______________________________ SCORE ______________

Construction workers often have to compute cubic yard measurements to estimate materials and labor. Cubic yards is the basic unit of measurement for concrete and other materials. Therefore, a construction worker must be able to calculate cubic yard measurements accurately.

Solve the following problems involving cubic yards. Refer to Information Sheet, Section XXIX, if necessary.

A. How many cubic yards of concrete will it take for a driveway 20 feet wide by 72 feet long by 4 inches thick?

Total cubic yards = ________________

B. Find the total cubic yards of fill it will take to fill a cavity 8 feet high, 22 feet long, and 6 inches thick?

Total cubic yards = ________________

C. How many cubic yards of grout will it take to fill a cavity 12 feet high, 37 feet long, and 3 inches thick?

Total cubic yards = ________________

D. Find the total cubic yards of sand it will take to fill a swimming pool 34 feet wide, 45 feet long, and 4 inches thick?

Total cubic yards = ________________

E. How many cubic yards of concrete will it take to pour a sidewalk 6 feet wide, 118 feet long, and 4 inches thick?

Total cubic yards = ________________

BASIC MATH
UNIT II

ASSIGNMENT SHEET #22 — SOLVE BASIC RATIO AND PROPORTION PROBLEMS

NAME ______________________________ SCORE ______________

The concrete masonry trade uses more ratios and proportions today than ever before. New mastics, epoxy resins, and bonding agents often require mixing. Ratios are used to designate grade slopes and relationships such as heat loss and load-bearing capacities. The concrete mason will be required to calculate some ratios and proportions, and will be required to apply many others.

Solve the following ratio and proportion problems. Refer to Information Sheet, Section XXX, if necessary. Show your work.

A. Convert the ratio 0.25:0.25:1 to the smallest proportion possible containing whole numbers.

Proportion = ______________

B. What would be the proportion if a 1:2:12 mix were cut in half?

Proportion = ______________

C. What would be the proportion if the ratio 1:1:3 were tripled?

Proportion = ______________

D. You are asked to mix a batch of topping using a 1:1:6 ratio, but you will need six times this amount. What will be the proportion of material needed?

Proportion = ______________

E. A mixture of 1 part cement, 1 part pea gravel, and 3 parts sand is needed to make 25 cubic feet of topping. How many cubic feet of each are needed?

Cubic feet cement = ______________

Cubic feet pea gravel = ______________

Cubic feet sand = ______________

BASIC MATH
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

PART I

A. 11
B. 16
C. 13
D. 23
E. 108
F. 88
G. 242
H. 1538
I. 1917
J. 16,430

PART II

A. 1175 lineal feet
B. 1135 doors
C. $609
D. 12,130 lineal feet

Assignment Sheet #2

PART I

A. 4
B. 7
C. 53
D. 406
E. 424
F. 283
G. 1175
H. 1810
I. 51,450
J. 89,722

PART II

A. 126 two-by-fours
B. 1160 lineal feet
C. 4410 square feet
D. 14,145 outlet boxes

Assignment Sheet #3

PART I

A. 42
B. 72
C. 324
D. 2884
E. 8410
F. 2028
G. 21,291
H. 165,478
I. 503,605
J. 5,458,852

PART II

A. 68,383 pounds
B. 8160 square feet
C. 2850 square feet
D. 1440 hours

Assignment Sheet #4

PART I

A. 4
B. 8
C. 91
D. 312
E. 3
F. 3
G. 62, R 4
H. 2, R 97
I. 1, R 365
J. 3, R 634

PART II

A. 2070 square feet
B. 8 windows, 4 inches
C. 975 square feet of colored concrete
D. 68 sheets

Assignment Sheet #5

PART I

A.
  1. 5,8
  2. numerator, denominator
  3. 1,4

B.
  1. $^{10}/_{16}$
  2. $^{16}/_{32}$

C.
  1. 1
  2. 8
  3. $^{1}/_{8}$

ANSWERS TO ASSIGNMENT SHEETS

PART II

A.
1. n
2. d
3. f
4. k
5. a
6. j
7. i
8. l
9. b
10. g
11. m
12. c
13. h
14. o
15. e

B. Evaluated to the satisfaction of the instructor

Assignment Sheet #6

A. $\frac{1}{2}$
B. $\frac{1}{2}$
C. 1
D. $\frac{1}{4}$
E. $\frac{1}{4}$
F. $\frac{3}{8}$
G. $\frac{1}{2}$
H. $\frac{1}{2}$
I. $\frac{3}{4}$
J. $\frac{1}{2}$

Assignment Sheet #7

PART I

A. 4
B. 8
C. 3
D. 5
E. 3
F. 20
G. 18
H. 9
I. 6
J. 28
K. 3
L. 7

PART II

A. $\frac{6}{16}$ and $\frac{8}{16}$
B. $\frac{96}{128}$ and $\frac{36}{128}$
C. $\frac{8}{128}$ and $\frac{80}{128}$
D. $\frac{16}{32}$ and $\frac{14}{32}$
E. $\frac{1536}{2048}$ and $\frac{1152}{2048}$ and $\frac{448}{2048}$

PART III

A. $\frac{6}{20}$ and $\frac{5}{20}$
B. $\frac{32}{48}$ and $\frac{9}{48}$
C. $\frac{24}{32}$ and $\frac{9}{32}$
D. $\frac{8}{16}$ and $\frac{7}{16}$
E. $\frac{30}{40}$ and $\frac{25}{40}$ and $\frac{28}{40}$

Assignment Sheet #8

PART I

A.
1. P
2. M
3. I
4. M
5. P
6. I
7. I
8. M
9. I
10. M
11. M
12. I
13. I
14. P
15. M

B. Evaluated to the satisfaction of the instructor

C. Evaluated to the satisfaction of the instructor

PART II

A.
1. $\frac{13}{4}$
2. $\frac{9}{2}$
3. $\frac{31}{4}$
4. $\frac{17}{2}$
5. $\frac{49}{8}$
6. $\frac{11}{2}$
7. $\frac{17}{4}$
8. $\frac{19}{2}$
9. $\frac{37}{4}$
10. $\frac{33}{2}$

B.
1. $1\frac{3}{4}$
2. $4\frac{1}{2}$
3. $1\frac{1}{2}$
4. $1\frac{7}{8}$
5. $1\frac{3}{16}$
6. $1\frac{3}{8}$
7. $2\frac{11}{32}$
8. $2\frac{1}{2}$
9. $3\frac{3}{4}$
10. $2\frac{1}{16}$

Assignment Sheet #9

A. $\frac{1}{2}$
B. 1
C. $\frac{23}{32}$
D. $1\frac{3}{16}$
E. $\frac{29}{32}$
F. $1\frac{3}{16}$
G. $1\frac{5}{16}$
H. $1\frac{25}{32}$
I. $\frac{5}{8}$ gallon
J. $1\frac{3}{32}$ inches
K. $2\frac{1}{3}$ squares
L. $1\frac{3}{16}$ inches
M. $5\frac{1}{4}$ inches

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #10

A. $\frac{9}{16}$
B. $\frac{5}{8}$
C. $\frac{3}{16}$
D. $\frac{5}{32}$
E. $\frac{3}{4}$
F. $\frac{9}{16}$
G. $\frac{1}{16}$
H. $\frac{3}{8}$
I. $\frac{17}{32}$
J. $\frac{1}{2}$
K. $\frac{1}{2}$ inch
L. $\frac{17}{32}$ inch
M. $\frac{1}{8}$ inch
N. $23\frac{7}{64}$ inches
O. $1\frac{3}{4}$ inches

Assignment Sheet #11

A. $\frac{3}{8}$
B. $\frac{15}{128}$
C. $3\frac{3}{8}$
D. $3\frac{1}{4}$
E. $\frac{7}{12}$
F. $1\frac{1}{2}$
G. $\frac{1}{24}$
H. $16\frac{27}{32}$
I. $2\frac{1}{8}$ feet
J. $\frac{1}{4}$ gallon
K. 74 nails
L. $4\frac{1}{3}$ pounds
M. $\frac{7}{8}$ inch

Assignment Sheet #12

A. $1\ \frac{1}{6}$
B. $\frac{3}{8}$
C. $1\ \frac{1}{24}$
D. $4\ \frac{2}{3}$
E. $2\ \frac{7}{10}$
F. $12\frac{2}{9}$
G. $\frac{3}{4}$
H. $13\ \frac{1}{3}$
I. $8\ \frac{1}{4}$
J. $42\ \frac{2}{3}$

Assignment Sheet #13

A. 0.189
B. 1.072
C. $9.22
D. 0.0102
E. $71.01
F. $131.32
G. 287.706
H. 0.4000
I. 6.455
J. 30024.88
K. 56.000
L. 0.87139
M. $164.80
N. 27.9 hours
O. $122.71
P. 1366.6 miles

Assignment Sheet #14

A. 351.98
B. 547.144
C. 141.013
D. 508.16
E. $749.25
F. 410[illegible].34
G. 603.7 miles
H. $1781.04
I. 0.0167 inch
J. $177.43 savings

Assignment Sheet #15

A. 8.184
B. 39.6
C. 1.1475
D. 297.5
E. 100.32
F. 6.4584
G. $337.45
H. $61,875.00
I. 24.975 feet
J. $132.62
K. 2079.375 pounds

Assignment Sheet #16

A. 9
B. 12.4
C. 33
D. 153
E. 1.5
F. 284
G. 0.8
H. 14,000
I. $8.64
J. 30.3 hours
K. 32 lots
L. $21.60
M. 0.75 hour

Assignment Sheet #17

PART I

A. 1. 0.125
2. 0.5
3. 0.625
4. 0.09375
5. 0.5625

B. 1. 25%
2. 70%
3. 100%
4. 87.5%
5. 33.3%

PART II

A. 1. d
2. a
3. b
4. c
5. e

B. 1. 63.9
2. 5.093
3. 3.825
4. 38.095
5. 402.3

PART III

A. 1. $\frac{1}{2}$
2. $\frac{1}{3}$
3. $\frac{7}{25}$
4. $\frac{21}{100}$
5. $\frac{2}{3}$

ANSWERS TO ASSIGNMENT SHEETS

B. 1. 0.47
   2. 0.15
   3. 0.333
   4. 0.62
   5. 0.75

Assignment Sheet #18

PART I

A. All work is completed
B. 14%
C. 86, 86%
D. 25%, 5%
E. 94%
F. 6, 6%
G. 89%
H. 94%
I. 40%
J. 50%

PART II

A. 2.16
B. 0.9
C. 32
D. 50
E. 43.18
F. 17.6
G. 1.03
H. 57
I. 16.4
J. 11.41

PART III

A. 12
B. 1
C. $24.00
D. 600

Assignment Sheet #19

A. 1. 64 square inches
   2. 256 square feet
   3. 225 square feet
   4. 1296 square yards

B. 1. 60 square feet
   2. 192 square yards
   3. 527 square inches
   4. 992 square feet

C. 1. 113.04 square inches
   2. 615.44 square feet
   3. 803.84 square feet
   4. 490.625 square yards

D. 1. 48 square inches
   2. 199.5 square feet
   3. 19.5 square inches
   4. 180 square yards

E. 1. 12 square feet
   2. 104 square yards
   3. 256 square inches
   4. 243 square yards

F. 1. 493 square inches
   2. 242 square yards
   3. 168 square feet
   4. 765 square yards

Assignment Sheet #20

PART I

(NOTE: Answers may be reversed in the width and length columns.)

	H	W	L	V
A.	3	3	2	18
B.	3	3	3	27
C.	2	3	3	18
D.	5	2	4	40
E.	3	2	2	12
F.	2	2	5	20
G.	1	2	3	6
H.	2	2	2	8
I.	3	2	3	18
J.	2	4	7	56

ANSWERS TO ASSIGNMENT SHEETS

PART II

A. 4 cubes
B. 2 cubes
C. 2 layers
D. 6 cubes
E. 12 cubes
F. 12 cubic units
G. 12 cubes
H. 3 layers
I. Answers will vary
J. 1728 cubic inches
K. 144 cubic inches
L. 288 cubic inches
M. 432 cubic inches
N. 12 layers
O. 27 cubic feet

PART III

A. 60 cubic feet
B. 63 cubic inches
C. 20 cubic yards
D. 60 cubic inches
E. 64 cubic yards
F. 40 cubic feet

Assignment Sheet #21

(NOTE: Answers vary slightly depending on method used to make computations.)

A. 17.77 or 17.60 cubic yards
B. 3.259 or 3.52 cubic yards
C. 4.11 cubic yards
D. 18.88 or 18.70 cubic yards
E. 8.74 or 8.65 cubic yards

Assignment Sheet #22

A. 1:1:4
B. 0.5:1:6
C. 3:3:9
D. 6:6:36
E. 5 cubic feet cement
5 cubic feet pea gravel
15 cubic feet sand

BASIC MATH
UNIT II

TEST

NAME ____________________________________ SCORE ______________

1. Match to their correct definitions terms associated with basic math. Write the correct numbers in the blanks.

_____a. To solve by mathematical process

_____b. Process of totaling two or more numbers to find another number called a *sum*

_____c. Fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the number

_____d. Any one of the ten symbols, 0 to 9, by which all numbers can be expressed

_____e. Opposite (inverse) operation of multiplication

_____f. Part of a whole; represents one or more equal parts of a unit

_____g. Any of the natural numbers, both positive and negative, that represents a complete item

_____h. Pertaining to nominal units based on a 4-inch module

_____i. Abbreviated process of adding a number to itself a specified number of times

_____j. Theoretical size that may vary from the actual

_____k. One part in a hundred; reckoned on the basis of a whole divided into one hundred parts

_____l. Mathematical proposition

_____m. Being relatively equal in size or quantity

_____n. Relationship in quantity, amount, or size between two or more things

_____o. Opposite (inverse) operation of addition

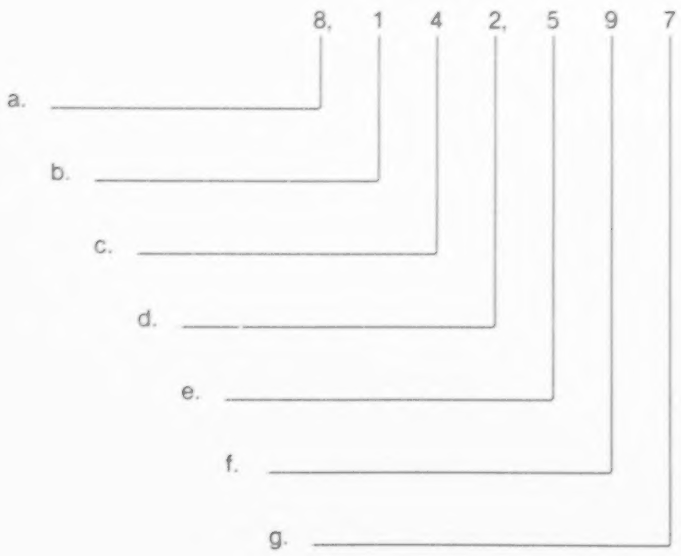
1. Digit
2. Multiplication
3. Problem
4. Nominal size
5. Subtraction
6. Whole number (integer)
7. Addition
8. Modular
9. Calculate
10. Fraction
11. Ratio
12. Proportional
13. Division
14. Decimal
15. Percent

TEST

2. Match to their correct names symbols used in math problems. Write the correct numbers in the blanks.

______a.	Plus sign (addition)	1. =
______b.	Pi sign	2. ×
______c.	Equal sign	3. −
______d.	Division frame	4. ÷
______e.	Ratio symbol	5. +
______f.	Minus sign (subtraction)	6. .
______g.	Percent symbol	7. π
______h.	Times sign (multiplication)	8. %
______i.	Decimal point	9. :
______j.	Division sign	10. $\overline{)}$

3. Label the place values in the whole number below.



TEST

4. Add whole numbers to solve the following problems. Show your work.

a. $\begin{array}{r} 2 \\ +\ 9 \\ \hline \end{array}$ b. $\begin{array}{r} 5 \\ 7 \\ +\ 8 \\ \hline \end{array}$ c. $\begin{array}{r} 12 \\ 17 \\ +\ 99 \\ \hline \end{array}$ d. $\begin{array}{r} 142 \\ 759 \\ +\ 896 \\ \hline \end{array}$ e. $\begin{array}{r} 2345 \\ 9764 \\ +\ 8976 \\ \hline \end{array}$

5. Subtract whole numbers to solve the following problems. Check your answers and show your work.

a. $\begin{array}{r} 9 \\ -\ 7 \\ \hline \end{array}$ b. $\begin{array}{r} 35 \\ -\ 9 \\ \hline \end{array}$ c. $\begin{array}{r} 481 \\ -\ 79 \\ \hline \end{array}$ d. $\begin{array}{r} 684 \\ -\ 342 \\ \hline \end{array}$ e. $\begin{array}{r} 9867 \\ -\ 8748 \\ \hline \end{array}$

6. Multiply whole numbers to solve the following problems. Show your work.

a. $\begin{array}{r} 7 \\ \times\ 5 \\ \hline \end{array}$ b. $\begin{array}{r} 68 \\ \times\ 9 \\ \hline \end{array}$ c. $\begin{array}{r} 735 \\ \times\ 68 \\ \hline \end{array}$ d. $\begin{array}{r} 649 \\ \times\ 537 \\ \hline \end{array}$ e. $\begin{array}{r} 8673 \\ \times\ 642 \\ \hline \end{array}$

7. Divide whole numbers to solve the following problems. Show your work.

a. $4\overline{)48}$ b. $16\overline{)64}$ c. $38\overline{)608}$

TEST

d. $421\overline{)842}$ e. $317\overline{)4569}$ f. $530\overline{)80960}$

8. Distinguish among types of fractions. Write a "P" in the blanks before proper fractions, an "I" before improper fractions, and an "M" in the blanks before mixed numbers.

_____a. $^{1}/_{2}$

_____b. $8^{3}/_{4}$

_____c. $^{8}/_{8}$

_____d. $15^{3}/_{8}$

_____e. $5^{3}/_{16}$

_____f. $^{10}/_{32}$

_____g. $^{2}/_{8}$

_____h. $6^{1}/_{2}$

_____i. $^{1}/_{4}$

_____j. $^{99}/_{1}$

9. Reduce the following fractions to lowest terms. Write your answers in the blanks.

__________a. $^{4}/_{8}$

__________b. $^{8}/_{16}$

__________c. $^{7}/_{16}$

__________d. $^{8}/_{32}$

__________e. $^{12}/_{32}$

__________f. $^{4}/_{16}$

__________g. $^{2}/_{16}$

__________h. $^{8}/_{64}$

__________i. $^{12}/_{16}$

__________j. $^{31}/_{32}$

10. Convert the following mixed numbers to improper fractions. Reduce to lowest terms if possible. Write your answers in the blanks.

__________a. $3\frac{1}{2}$

__________b. $4\frac{2}{4}$

__________c. $3\frac{6}{8}$

__________d. $12\frac{4}{8}$

__________e. $13\frac{13}{32}$

TEST

11. Convert the following improper fractions to mixed numbers. Reduce answers to lowest terms. Write your answers in the blanks.

__________ a. $\frac{47}{8}$

__________ b. $\frac{21}{9}$

__________ c. $\frac{108}{23}$

__________ d. $\frac{54}{5}$

__________ e. $\frac{112}{7}$

12. Add fractions to solve the following problems. Convert to mixed numbers if necessary, and reduce to lowest terms. Write your answers in the blanks.

__________ a. $\frac{1}{8} + \frac{5}{8}$

__________ b. $\frac{1}{16} + \frac{15}{16}$

__________ c. $\frac{2}{4} + \frac{3}{4}$

__________ d. $\frac{1}{2} + \frac{4}{8}$

__________ e. $\frac{4}{8} + \frac{2}{4}$

__________ f. $\frac{7}{8} + \frac{6}{16}$

__________ g. $2\frac{1}{8} + 7\frac{1}{4}$

__________ h. $3\frac{2}{4} + 16\frac{1}{8}$

__________ i. $4\frac{2}{4} + 8\frac{2}{8}$

__________ j. $5\frac{1}{8} + 6\frac{2}{16}$

13. Subtract fractions to solve the following problems. Reduce answers to lowest terms. Write your answers in the blanks.

__________ a. $\frac{4}{8} - \frac{3}{8}$

__________ b. $\frac{6}{8} - \frac{2}{8}$

__________ c. $\frac{9}{16} - \frac{4}{16}$

__________ d. $\frac{3}{8} - \frac{1}{4}$

__________ e. $\frac{3}{8} - \frac{1}{8}$

__________ f. $\frac{14}{16} - \frac{7}{8}$

__________ g. $2\frac{3}{4} - 1\frac{1}{4}$

__________ h. $6\frac{1}{8} - 2\frac{1}{2}$

__________ i. $9\frac{2}{4} - 4\frac{1}{2}$

__________ j. $12\frac{6}{8} - 7\frac{1}{8}$

TEST

14. Multiply fractions to solve the following problems. Reduce to lowest terms. Write your answers in the blanks.

____________a. $\frac{1}{2} \times \frac{3}{4}$

____________b. $\frac{3}{4} \times \frac{3}{8}$

____________c. $\frac{3}{2} \times \frac{1}{16}$

____________d. $\frac{3}{4} \times 6\frac{1}{2}$

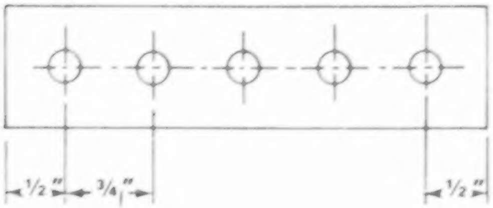
____________e. $6\frac{3}{4} \times 8\frac{3}{4}$

____________f. $7\frac{1}{8} \times 1\frac{1}{2}$

____________g. $\frac{77}{16} \times 5$

____________h. A piece of expansion material is 15 feet long. Someone cut off $^1/_{20}$ of its total length. How long is the cut piece? (Convert your answer to inches.)

____________i. The bolt template illustrated below is to be drilled with 5 holes equally spaced. Find the length of the template.



____________j. Two trucks are used to haul crushed rock. The larger truck hauls $3^1/_2$ cubic yards per load, and the other hauls $2^1/_4$ cubic yards per load. If each truck hauls 16 loads, what is the total quantity in cubic yards of crushed rock hauled?

TEST

15. Divide fractions to solve the following problems. Reduce to lowest terms. Write your answers in the blanks. Show your work.

a. $\frac{3}{8} \div \frac{3}{4} =$ ____________________

b. $2\frac{1}{2} \div \frac{2}{3} =$ ____________________

c. $\frac{3}{4} \div 5 =$ ____________________

d. $4\frac{1}{3} \div \frac{3}{8} =$ ____________________

e. $5\frac{3}{8} \div 3\frac{1}{4} =$ ____________________

f. $6\frac{2}{3} \div 2 =$ ____________________

g. $1\frac{7}{9} \div 5\frac{1}{4} =$ ____________________

h. A truck is loaded with stones, and each stone weighs approximately 1/20 of a ton. If the total weight of the stones is 1 3/4 tons, how many stones are on the truck?

____________ stones

TEST

i. How many 9-inch-square blocks will be needed to make a sidewalk that is 3 feet wide and 15 feet long?

____________________ blocks

j. If 1/8 cubic yard of cement is needed to mix 1 cubic yard of concrete, how many cubic yards can be mixed using 7/8 cubic yards of cement?

____________________ cubic yards

16. Label the place values in the decimal number below.

0. 9 6 1 2 8 5

f.______________________________

e.______________________________

d.______________________________

c.______________________________

b.______________________________

a.______________________________

17. Add decimal numbers to solve the following problems. Set up each problem and show your work. Write your answers in the blanks.

__________ a. 3.5 + 5.1 + 7

__________ b. 3.4 + 0.206 + 1.74

__________ c. \$6.86 + \$5.05 + \$7.90 + \$.82

TEST

___________d. 57.78 + 0.22 + 0.003 + 74

___________e. 6319 + 95.12 + 0.0713 + 321.07

18. Subtract decimal numbers to solve the following problems. Set up each problem and check your work. Write your answers in the blanks.

___________a. \$6.10 − \$2.20

___________b. \$5.40 − \$2.32

___________c. \$7.38 − \$.63

___________d. 0.835325 − 0.25

___________e. 0.609375 − 0.359375

TEST

19. Multiply decimal numbers to solve the following problems. Set up each problem and show your work. Write your answers in the blanks.

____________a. 2.6 × 4.7

____________b. 0.119 × 0.05

____________c. 9 × 0.08

____________d. 7.392 × 92.07

____________e. 9.5 × 0.76

20. Divide decimals to solve the following problems. Set up each problem and check your work. Write your answers in the blanks.

____________a. 5.32 ÷ 0.4

____________b. 83.4 ÷ 0.6

TEST

__________c. 0.0225 ÷ 0.15

__________d. 54 ÷ 0.09

__________e. 812 ÷ 0.058

21. Convert the following fractions to decimal numbers and percentages. Give percentages in the nearest whole percent. Write your answers in the blanks.

Decimal Number	Percentage	
__________	__________	a. $^{1}/_{3}$
__________	__________	b. $23^{3}/_{100}$
__________	__________	c. $^{7}/_{16}$
__________	__________	d. $8^{13}/_{100000}$
__________	__________	e. $18^{3}/_{10}$

TEST

22. Identify decimal and fractional equivalents. Write the correct answers in the blanks.

$\frac{1}{64}$	.015625
$\frac{1}{32}$	.03125
$\frac{3}{64}$	.046875
$\frac{1}{16}$	.0625
$\frac{5}{64}$	.078125
$\frac{3}{32}$	.09375
$\frac{7}{64}$	.109375
a.____	**.125**
$\frac{9}{64}$	.140625
$\frac{5}{32}$	.15625
$\frac{11}{64}$	.171875
$\frac{3}{16}$	.1875
$\frac{13}{64}$	.203125
$\frac{7}{32}$	.21875
$\frac{15}{64}$	.234375
$\frac{1}{4}$	b.________
$\frac{17}{64}$	.265625
$\frac{9}{32}$	.28125
$\frac{19}{64}$	.296875
$\frac{5}{16}$	.3125
$\frac{21}{64}$	.328125
$\frac{11}{32}$	.34375
$\frac{23}{64}$	.359375
c.____	**.375**
$\frac{25}{64}$	.390625
$\frac{13}{32}$	.40625
$\frac{27}{64}$	.421875
$\frac{7}{16}$	.4375
$\frac{29}{64}$	.453125
$\frac{15}{32}$	.46875
$\frac{31}{64}$	.484375
$\frac{1}{2}$	d.________

$\frac{33}{64}$	.515625
$\frac{17}{32}$	.53125
$\frac{35}{64}$	.546875
$\frac{9}{16}$	.5625
$\frac{37}{64}$	.578125
$\frac{19}{32}$	.59375
$\frac{39}{64}$	.609375
$\frac{5}{8}$	e.________
$\frac{41}{64}$	.640625
$\frac{21}{32}$	.65625
$\frac{43}{64}$	.671875
$\frac{11}{16}$	.6875
$\frac{45}{64}$	.703125
$\frac{23}{32}$	.71875
$\frac{47}{64}$	.734375
f.____	**.75**
$\frac{49}{64}$	.765625
$\frac{25}{32}$	.78125
$\frac{51}{64}$	.796875
$\frac{13}{16}$	.8125
$\frac{53}{64}$	.828125
$\frac{27}{32}$	.84375
$\frac{55}{64}$	.859375
$\frac{7}{8}$	g.________
$\frac{57}{64}$	.890625
$\frac{29}{32}$	.90625
$\frac{59}{64}$	.921875
$\frac{15}{16}$	.9375
$\frac{61}{64}$	.953125
$\frac{31}{32}$	.96875
$\frac{63}{64}$	.984375
1	h.________

TEST

23. Convert the following percentages to fractions and decimal numbers. Write your answers in the blanks.

Decimal Number	Fraction	
____________	____________	a. 12%
____________	____________	b. 30%
____________	____________	c. 45%
____________	____________	d. 72%
____________	____________	e. 250%

24. Solve the following percentage problems. Write your answers in the blanks.

__________a. If a contractor paid a concrete mason $150.00, which is 87 percent of his salary, how much more money would the concrete mason have coming?

__________b. If 12 percent of the bricks for a job are stolen, how many bricks will be left of the 2100 stored for the job?

__________c. If a contractor bought a forklift for $24,000, and sold it for $30,000, what was her percentage of profit?

TEST

25. Match terms used in geometry to their correct definitions. Write the correct numbers in the blanks.

______a. Volume of an object that is 1 foot long, 1 foot wide, and 1 foot high

______b. Shape formed by straight or curved lines

______c. Line or surface at a right angle to another line or surface

______d. Outer limits or boundary

______e. Greek letter (π) representing the ratio of a circle's circumference to its diameter; ratio approximately 3.1416

______f. Distance around outer edge of a circle

______g. Distance between outer edges of circle through center point

______h. Measure of a flat surface; expressed in square units

______i. Line from center of a circle to any point on edge of circle

______j. Relating to, consisting of, or resembling a straight line

______k. Extending in the same direction; equal distance apart and never meeting

______l. Space occupied by a body; expressed in cubic units

______m. Angle formed by two lines perpendicular to each other; 90-degree angle

______n. Unit with three equal dimensions, including length, width, and height

1. Perimeter
2. Radius
3. Volume
4. Lineal
5. Parallel
6. Diameter
7. Geometric figure
8. Area
9. Cubic foot
10. Circumference
11. Cubic unit
12. Right angle
13. Pi
14. Perpendicular

TEST

26. Match types of geometric figures to their correct descriptions. Write the correct numbers in the blanks.

_____a. Figure having three sides and three angles

_____b. Figure having four sides of equal length and four right angles

_____c. Flat, round figure formed by one curved line; all points of curved line are equidistant from center point

_____d. Figure having no right angles and four sides of equal length

_____e. Figure with only one pair of parallel opposite sides

_____f. Figure with two parallel ends of equal length, two parallel sides of equal length, and four right angles

_____g. Figure such as a square, rectangle, or rhombus with two parallel ends of equal length and two parallel sides of equal length

1. Circle
2. Parallelogram
3. Trapezoid
4. Triangle
5. Rectangle
6. Rhombus
7. Square

27. Match units of measure to their correct equivalents. Write the correct numbers in the blanks.

_____a. Equal to five thousand, two hundred and eighty feet (5280′)

_____b. Equal to one-twelfth of a foot ($^{1}/_{12}$′) or one thirty-sixth of a yard ($^{1}/_{36}$ yard)

_____c. Equal to three feet (3′) or thirty-six inches (36″)

_____d. Equal to $^{1}/_{360}$ of a circle

_____e. Equal to sixteen and one-half feet (16$^{1}/_{2}$′)

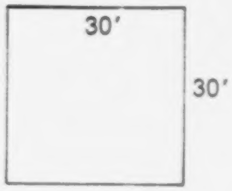
_____f. Equal to twelve inches (12″) or one-third of a yard ($^{1}/_{3}$ yard)

1. Inch (″)
2. Foot (′)
3. Yard
4. Rod
5. Mile
6. Degree (°)

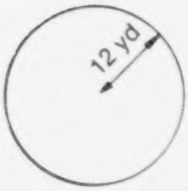
TEST

28. Calculate the area of each of the following geometric figures. Show your work. Write the correct answers in the blanks.

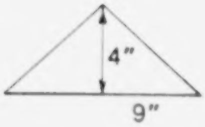
__________a.



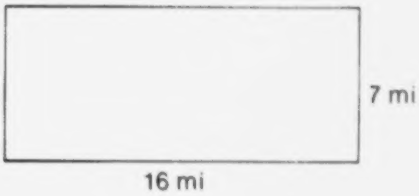
__________b.



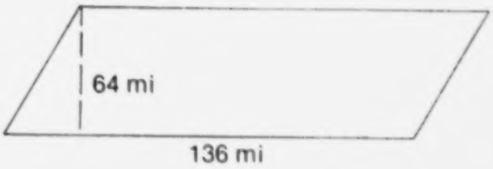
__________c.



__________d.

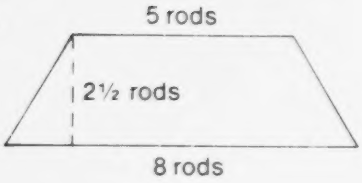


__________e.



TEST

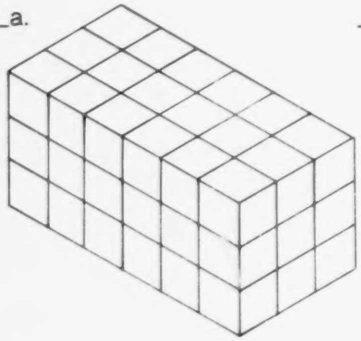
__________f.


5 rods
2½ rods
8 rods

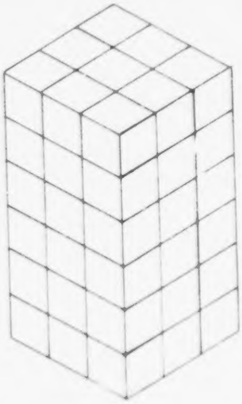
29. Calculate volume of the following solid figures. Write the correct answers in the blanks.

Counting

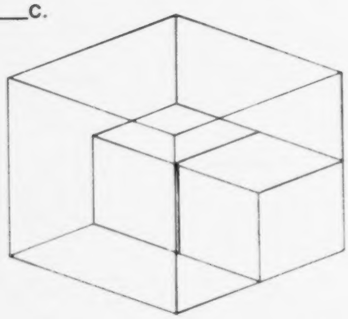
__________a.



__________b.

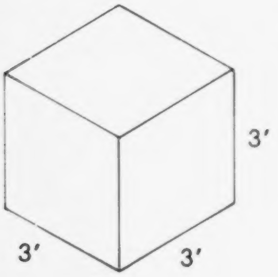


__________c.

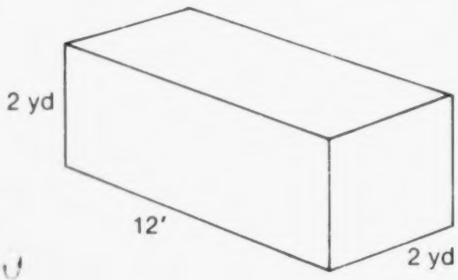


Using formula and converting as necessary

__________a.

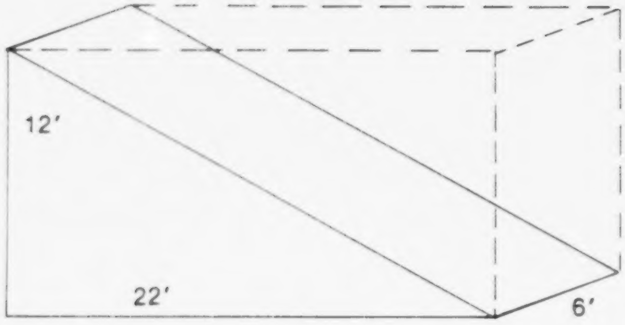


__________b.



TEST

__________ c.



__________ d. How many cubic yards of concrete will it take to fill a form 43 feet long, 36 feet wide, and 6 inches high?

__________ e. How many cubic yards of sand will it take to fill the bed of a truck 3 feet deep, 8½ feet wide, and 12 feet long?

__________ f. What would be the volume in cubic yards of a form 12 inches high, 72 inches long, and 36 inches wide?

__________ g. How many cubic yards of concrete are needed to fill an area 12 feet wide, 144 feet long, and 12 inches deep?

TEST

30. Solve the following basic ratio and proportion problems. Write your answers in the blanks.

__________a. Convert the ratio 0.5:0.5:2 to the smallest whole-number proportion.

__________b. Convert the ratio 1:1:3 to a decimal proportion.

__________c. What would be the proportion if a mix of 2.5:2.5:5 were doubled?

__________d. What would be the proportion if a 3:3:12 mix were cut to one-third?

__________e. If a mixture of 2 parts cement, 4 parts lime, and 6 parts sand were needed to do a job, what would the proportion be?

f. Referring to problem "e", how many cubic feet of each proportion would it take to make 36 cubic feet of mortar?

Cubic feet cement __________

Cubic feet lime __________

Cubic feet sand __________

BASIC MATH
UNIT II

ANSWERS TO TEST

1.
   a. 9
   b. 7
   c. 14
   d. 1
   e. 13
   f. 10
   g. 6
   h. 8
   i. 2
   j. 4
   k. 15
   l. 3
   m. 12
   n. 11
   o. 5

2.
   a. 5
   b. 7
   c. 1
   d. 10
   e. 9
   f. 3
   g. 8
   h. 2
   i. 6
   j. 4

3.
   a. Millions
   b. Hundred thousands
   c. Ten thousands
   d. Thousands
   e. Hundreds
   f. Tens
   g. Units

4.
   a. 11
   b. 20
   c. 128
   d. 1797
   e. 21,085

5.
   a. 2
   b. 26
   c. 402
   d. 342
   e. 1119

6.
   a. 35
   b. 612
   c. 49,980
   d. 348,513
   e. 5,568,066

7.
   a. 12
   b. 4
   c. 16
   d. 2
   e. 14, R 131
   f. 152, R 400

8.
   a. P
   b. M
   c. I
   d. M
   e. M
   f. P
   g. P
   h. M
   i. P
   j. I

9.
   a. $\frac{1}{2}$
   b. $\frac{1}{2}$
   c. $\frac{7}{16}$
   d. $\frac{1}{4}$
   e. $\frac{3}{8}$
   f. $\frac{1}{4}$
   g. $\frac{1}{8}$
   h. $\frac{1}{8}$
   i. $\frac{3}{4}$
   j. $\frac{31}{32}$

10.
   a. $\frac{7}{2}$
   b. $\frac{9}{2}$
   c. $\frac{15}{4}$
   d. $\frac{25}{2}$
   e. $\frac{429}{32}$

11.
   a. $5\frac{7}{8}$
   b. $2\frac{1}{3}$
   c. $4\frac{16}{23}$
   d. $10\frac{4}{5}$
   e. 16

12.
   a. $\frac{3}{4}$
   b. 1
   c. $1\frac{1}{4}$
   d. 1
   e. 1
   f. $1\frac{1}{4}$
   g. $9\frac{3}{8}$
   h. $19\frac{5}{8}$
   i. $12\frac{3}{4}$
   j. $11\frac{1}{4}$

13.
   a. $\frac{1}{8}$
   b. $\frac{1}{2}$
   c. $\frac{5}{16}$
   d. $\frac{1}{8}$
   e. $\frac{1}{4}$
   f. 0
   g. $1\frac{1}{2}$
   h. $3\frac{5}{8}$
   i. 5
   j. $5\frac{5}{8}$

ANSWERS TO TEST

14. a. $\frac{3}{8}$
b. $\frac{9}{32}$
c. $\frac{3}{32}$
d. $4\frac{7}{8}$
e. $59\frac{1}{16}$
f. $10\frac{11}{16}$
g. $24\frac{1}{16}$
h. 9 inches
i. 4 inches
j. 92 cubic yards

15. a. $\frac{1}{2}$
b. $3\frac{3}{4}$
c. $\frac{3}{20}$
d. $11\frac{5}{9}$
e. $1\frac{17}{26}$
f. $3\frac{1}{3}$
g. $\frac{64}{189}$
h. 35 stones
i. 80 blocks
j. $7\frac{7}{8}$ cu yd

16. a. Tenths
b. Hundredths
c. Thousandths
d. Ten thousandths
e. Hundred thousandths
f. Millionths

17. a. 15.6
b. 5.346
c. $20.63
d. 132.003
e. 6735.2613

18. a. $3.90
b. $3.08
c. $6.75
d. 0.585325
e. 0.25

19. a. 12.22
b. 0.00595
c. 0.72
d. 680.58144
e. 7.22

20. a. 13.3
b. 139
c. 0.15
d. 600
e. 14,000

21. a. 0.3333; 33%
b. 23.03; 2303%
c. 0.4375; 44%
d. 8.00013; 800%
e. 18.3; 1830%

22. a. $\frac{1}{8}$
b. .25
c. $\frac{3}{8}$
d. .5
e. .625
f. $\frac{3}{4}$
g. .875
h. 1.

23. a. 0.12; $\frac{3}{25}$
b. 0.30; $\frac{3}{10}$
c. 0.45; $\frac{9}{20}$
d. 0.72; $\frac{18}{25}$
e. 2.50; $2\frac{1}{2}$

24. a. $22.41
b. 1848 bricks
c. 20 percent

25. a. 9
b. 7
c. 14
d. 1
e. 13
f. 10
g. 6
h. 8
i. 2
j. 4
k. 5
l. 3
m. 12
n. 11

26. a. 4
b. 7
c. 1
d. 6
e. 3
f. 5
g. 2

27. a. 5
b. 1
c. 3
d. 6
e. 4
f. 2

28. a. 900 square feet
b. 452.16 square yards
c. 18 square inches
d. 112 square miles
e. 8704 square miles
f. $16\frac{1}{4}$ square rods

ANSWERS TO TEST

29. **Counting**

    a. 54 cubic units
    b. 54 cubic units
    c. 8 cubic units

    Using formula and converting as necessary

    a. 1 cubic yard
    b. 16 cubic yards
    c. 29 $^{1}/_{3}$ cubic yards
    d. 28.66 or 28 $^{2}/_{3}$ cubic yards
    e. 11.33 or 11 $^{1}/_{3}$ cubic yards
    f. .66 or $^{2}/_{3}$ cubic yards
    g. 64 cubic yards

30. a. 1:1:4
    b. 0.33:0.33:1 or any other proportional decimal
    c. 5:5:10
    d. 1:1:4
    e. 2:4:6
    f. 6 cubic feet of cement, 12 cubic feet of lime, 18 cubic feet of sand

MEASURING
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to read rules and measure objects accurately. The student will show this ability by completing an assignment sheet, job sheet, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with measuring.
2. Identify basic measuring tools used by construction workers.
3. List common errors that contribute to incorrect measurements.
4. Identify graduations on a folding rule.
5. Read a folding rule to the nearest fraction of an inch.
6. Convert fractional inches to hundredths of a foot.
7. Identify graduations on an engineer's rule.
8. Read an engineer's rule to the nearest hundredth of a foot.
9. Identify graduations on a tape.
10. Read a tape to the nearest fraction of an inch.
11. Describe measuring methods used to square lines.
12. Measure objects.
13. Demonstrate the ability to use basic measuring tools and the 3-4-5 method to lay out the perimeter of a building on a concrete slab.

MEASURING
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Supplement #1 — Word Search of Measuring Terms

  D. Information sheet

  E. Assignment sheets

    1. Assignment Sheet #1 — Read Measurements on Folding and Engineer's Rules

    2. Assignment Sheet #2 — Measure Objects

    3. Assignment Sheet #3 — Convert Fractional Inches to Hundredths of a Foot

    4. Assignment Sheet #4 — Read Measurements on Tapes

  F. Answers to assignments sheets

  G. Job Sheet #1 — Use Basic Measuring Tools and the 3-4-5 Method to Lay Out the Perimeter of a Building on a Concrete Slab

  H. Test

  I. Answers to test

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Obtain materials to supplement unit.

    1. Folding rules, engineer's rules, and tapes for each class member

    2. Several pieces of lumber or metal of different lengths

    3. Equipment and materials needed to perform procedures outlined in assignment and job sheets

SUGGESTED ACTIVITIES

4. Competency profiles

   (NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or The Associated General Contractors of America, 1957 E Street N.W., Washington, D.C. 20006. Phone: 202-393-2040.)

C. Make copies of the supplement as desired.

D. Introduce unit to students.

E. Provide students with objective sheet.

F. Discuss unit and specific objectives, emphasizing how important measuring is to the construction trades and pointing out the importance of knowing how to read and use rules, tapes, and squares accurately.

G. Provide students with information, assignment, and job sheets.

H. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I, to discuss terms associated with measuring.

   - Use the chalkboard and actual items to supplement your explanation of each term.

   - Have students review terms by completing Supplement #1, measuring terms word search.

2. Use Information Sheet, Section II, to discuss basic measuring tools used by construction workers.

   - Obtain actual measuring tools and have students identify them.

   - Make flash cards containing pictures of the tools. Have students play games using the flash cards.

   - Discuss the importance of purchasing and using quality tools.

3. Use Information Sheet, Section III, to discuss common errors that contribute to incorrect measurements. Encourage students to double-check all measurements and math calculations.

SUGGESTED ACTIVITIES

4. Use Information Sheet, Section IV, to discuss graduations on a folding rule.
    - Provide each student with a folding rule.
    - Have students work in teams of two; have one team member point out various graduations on the folding rule for the other to identify.
5. Use Information Sheet, Section V, to discuss reading a folding rule to the nearest fraction of an inch.
    - Provide each student with a folding rule graduated in sixteenths.
    - Use a folding rule to illustrate the fourths, eighths, and sixteenths markings on the rule.
    - Have students use the folding rule to measure and record the lengths of several pieces of lumber or metal.
    - Have students practice reading a folding rule to the nearest fraction of an inch by completing Part I of Assignment Sheets #1 and #2.
6. Use Information Sheet, Section VI, to discuss converting fractional inches to hundredths of a foot.
    - Have students memorize the three steps in the conversion process outlined in the information sheet. Emphasize how easy this method is and how quickly fractions and inches can be converted once the method is learned.
    - Have students review the section on converting fractions in Unit I, "Basic Math."
    - Make flash cards with fractional inches on one side and the correct hundredths conversion on the other side. Have students team up to practice converting fractional inches to hundredths of a foot.
    - Have students practice converting fractional inches to hundredths of a foot by completing Assignment Sheet #3.
7. Use Information Sheet, Section VII, to discuss graduations on an engineer's rule.
    - Provide each student with an engineer's rule.
    - Have students work in teams of two; have one team member point out various graduations on the engineer's rule for the other to identify.
8. Use Information Sheet, Section VIII, to discuss reading an engineer's rule to the nearest hundredth of a foot.
    - Provide each student with an engineer's rule.

SUGGESTED ACTIVITIES

- Have students use the engineer's rule to measure and record the lengths of the pieces of lumber or metal gathered for Section V. Compare their measurements, and explain the importance of converting from inches to hundredths or from hundredths to inches.
- Have students practice reading an engineer's rule to the nearest hundredth of a foot by completing Part II of Assignment Sheets #1 and #2.
- Draw lines on poster board or on the floor. Have students practice measuring the lines.

9. Use Information Sheet, Sections IX and X, to discuss graduations on a tape and reading a tape to the nearest fraction of an inch.
   - Provide each student with a tape.
   - Have students use procedures outlined in the information sheet to complete Assignment Sheet #4, "Read Measurements on Tapes."
   - Have students practice measuring the lengths and widths of the classroom, the shop, the building, and so on.
   - Provide a practice exercise in which students have to make general measurements within a specified time.
   - Discuss and demonstrate procedures outlined in Job Sheet #1, using the floor plan furnished with the job sheet. Have students measure and lay out interior dimensions and partition walls if desired.
10. Use Information Sheet, Section XI, and Job Sheet #1 to explain and demonstrate the 3-4-5 and diagonal methods used to square lines.

I. Give test.

J. Critique test and discuss in class.

K. Reteach and retest as necessary.

L. Complete appropriate section of competency profiles.

III. Unit reference

Hendrix, Laborn J., "Bud." *Fundamentals of Carpentry.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1985.

MEASURING
UNIT III

SUPPLEMENT #1 — WORD SEARCH OF MEASURING TERMS

The following measuring terms are hidden in the puzzle below. Find and circle each term. Words may be spelled forward, backward, from top to bottom, or diagonally. A score of 8 is good, 10 is excellent, and 15 is super.

- DIMENSIONS
- DIVISIONS
- FOOT
- FRACTION
- GRADUATIONS
- INCH
- KEEL
- LAYOUT
- LINEAL
- MEASURING
- MODULAR
- PERIMETER
- RECTANGLE
- RULE
- TAUT
- UNIT

```
D I M E N S I O N S N O I T A U D A R G M
P R B G R P D S Z N T C R G N L J Q U N O
F E E Y V C S T U O Y A L F T B D R L L D
B R R C T F W F O I D P G W L K P G E M U
J W A I T D C F D S X H Y C G F D E B S L
R R C C M A X G K I N C H R B X K R D K A
Z B S T T E N R B V Y V B F M V S W H F R
T P U T V I T G L I X M E A S U R I N G R
D A N S J L O E L D K T R C L P R C B P D
T I N U H B K N R E L I N E A L J M S B G
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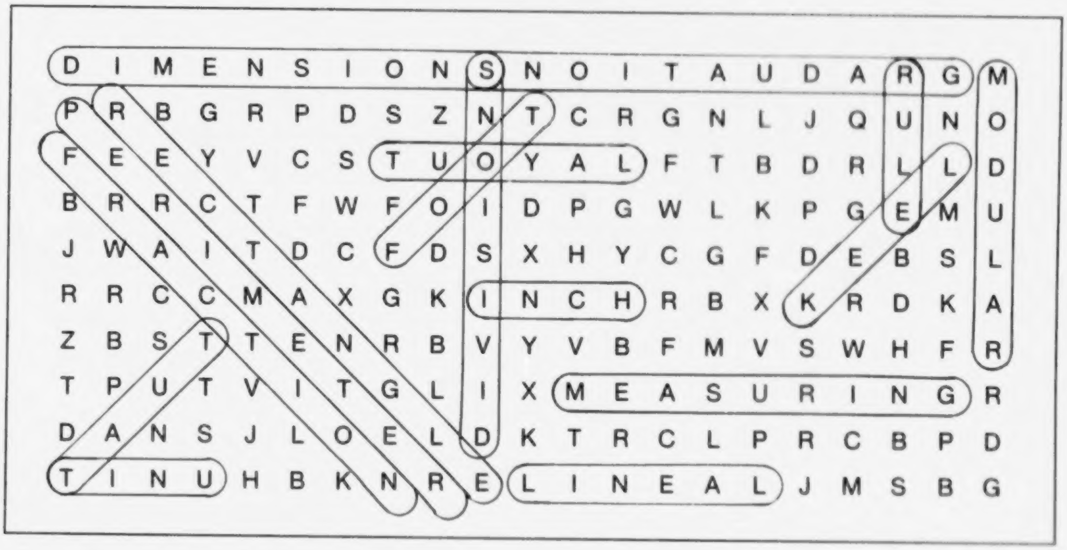
SUPPLEMENT #1



D	I	M	E	N	S	I	O	N	S	N	O	I	T	A	U	D	A	R	G	M
P	R	B	G	R	P	D	S	Z	N	T	C	R	G	N	L	J	Q	U	N	O
F	E	E	Y	V	C	S	T	U	O	Y	A	L	F	T	B	D	R	L	L	D
B	R	R	C	T	F	W	F	O	I	D	P	G	W	L	K	P	G	E	M	U
J	W	A	I	T	D	C	F	D	S	X	H	Y	C	G	F	D	E	B	S	L
R	R	C	C	M	A	X	G	K	I	N	C	H	R	B	X	K	R	D	K	A
Z	B	S	T	T	E	N	R	B	V	Y	V	B	F	M	V	S	W	H	F	R
T	P	U	T	V	I	T	G	L	I	X	M	E	A	S	U	R	I	N	G	R
D	A	N	S	J	L	O	E	L	D	K	T	R	C	L	P	R	C	B	P	D
T	I	N	U	H	B	K	N	R	E	L	I	N	E	A	L	J	M	S	B	G

MEASURING
UNIT III

INFORMATION SHEET

I. Terms and definitions associated with measuring

A. **Measuring** — Setting of limits or bounds according to a predetermined standard

(NOTE: The standard used in measuring is called a *unit of measurement* or simply *unit.* Examples of units used to measure distance include inches, feet, meters, and miles.)

B. **Rule** — Measuring instrument graduated in whole units and fractions of units

(NOTE: The term *rule* is generally applied to any measuring instrument used to determine distances. One special kind of rule is the *tape,* a steel strip marked in graduations. Tapes can be reeled into a container. In construction, a rule is usually used for measuring distances of a few feet or less and for marking straight lines. A tape is used for measuring distances from a few inches to a hundred feet or more.)

C. **Graduations** — Marks on a rule or tape indicating measurements

EXAMPLES: Sixteenths, quarters, halves, inches, and feet; hundredths, tenths, and feet

D. **Foot** — Unit of measure consisting of twelve equal parts called *inches*

E. **Inch** — Smallest whole unit of lineal measure commonly used

F. **Divisions** — Parts or sections that make up 1 inch on a rule

G. **Fraction** — Part of a whole; represents one or more equal parts of a unit

EXAMPLES: $^1/_2$, $^3/_8$, $^1/_4$, $^3/_{16}$

H. **Lineal** — Relating to, consisting of, or resembling a straight line

I. **Dimensions** — Arrangement of lines to indicate the actual size for constructing the object or structure represented

J. **Layout** — Plan or design of the project to be constructed

K. **Perimeter** — Outer limits or boundaries

L. **Keel** — Type of colored marking crayon used in construction

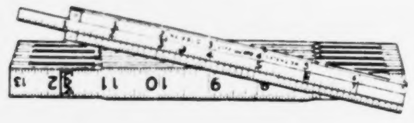
M. **Taut** — Tightly stretched; not slack

INFORMATION SHEET

II. Basic measuring tools used by construction workers (Figures 1-9)

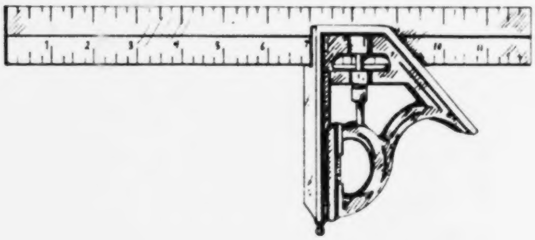
A. Folding rule

FIGURE 1



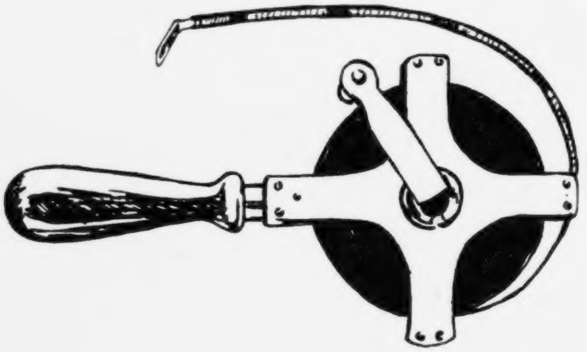
B. Combination square

FIGURE 2



C. Two-hundred-foot steel tape and reel

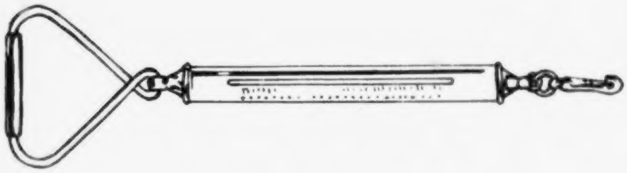
FIGURE 3



INFORMATION SHEET

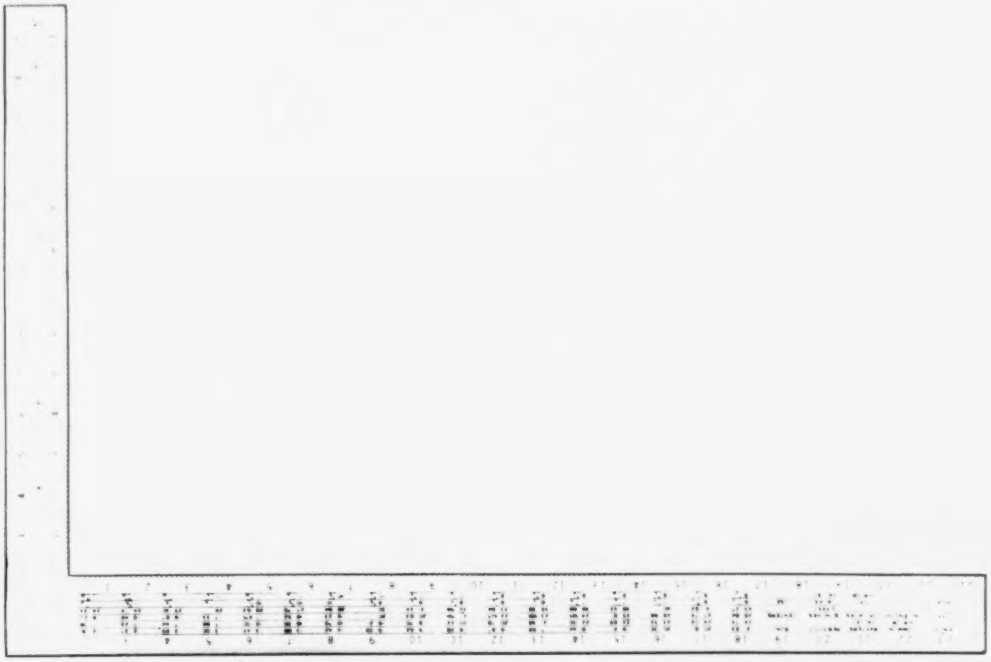
D. Spring-balanced tape-tension handle

FIGURE 4



E. Steel framing square

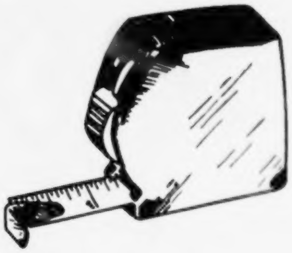
FIGURE 5



INFORMATION SHEET

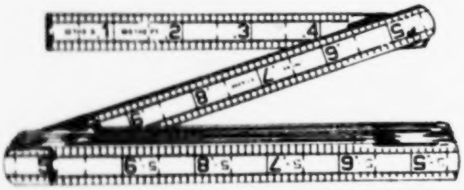
F. Sixteen-foot steel tape

FIGURE 6



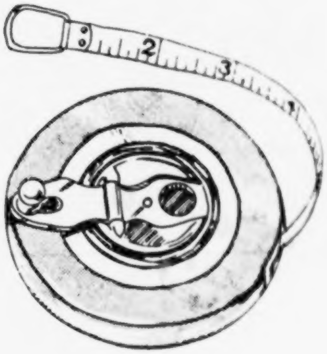
G. Engineer's folding rule

FIGURE 7



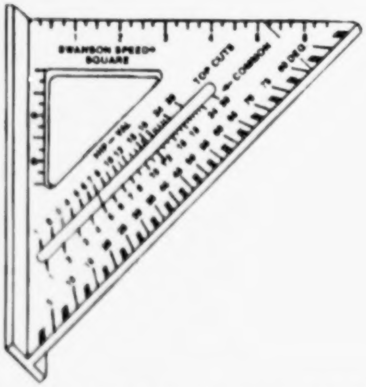
H. One-hundred-foot steel tape

FIGURE 8



I. Triangular rafter square

FIGURE 9



Speed™square used with permission of the Swanson Tool Company, Inc., Frankfort, Illinois.

III. Common errors that contribute to incorrect measurements

A. Leaving slack in tape

B. Not laying tape flat (tape is twisted or kinked)

C. Not aligning tape or rule properly

D. Not placing end of tape or rule on reference point

E. Reading incorrect number

F. Recording incorrect number

G. Using wrong reference point

H. Making errors in mathematical computations

EXAMPLE: When converting from one unit of measurement to another

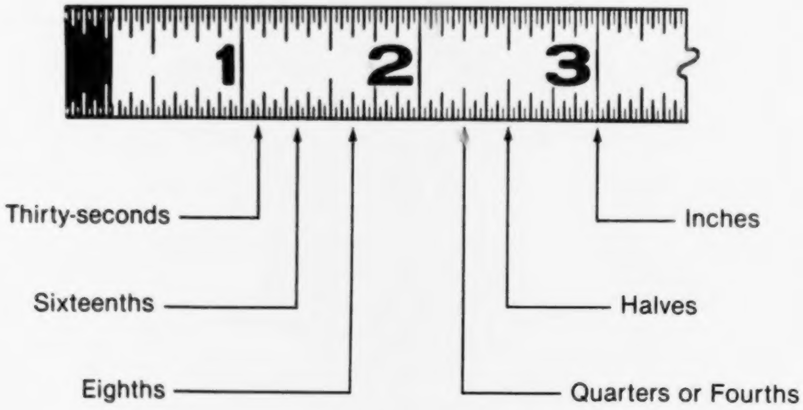
I. Using incorrect measuring tool for job being performed

INFORMATION SHEET

IV. Graduations on a folding rule (Figure 10)

(NOTE: Some rules will not have all of the graduations shown in Figure 10.)

FIGURE 10



(NOTE: Thirty-two 32nds equal 1 inch. Sixteen 16ths equal 1 inch. Eight 8ths equal 1 inch. Four 4ths equal 1 inch. Two halves equal 1 inch. Twelve inches equal 1 foot.)

V. Reading a folding rule to the nearest fraction of an inch

(NOTE: All rules are read similarly. However, rules may have different graduations, and some rules may have special markings for specific purposes. Layout rules, for instance, are marked every 16 inches as an aid in determining stud locations on 16-inch centers.)

A. Align the end of the rule with one reference point

B. Determine the number of whole units between end of rule and second reference point

(NOTE: The unit of measurement will vary, depending on the distance being measured and the use being made of the measurement. Most short measurements are made in inches, even if they are more than 1 foot long. Skilled construction workers are generally able to convert measurements from feet to inches or vice versa quickly for distances of 10 to 12 feet or more. Thus, a construction worker may speak of a sheet of plywood as 4 by 8 feet or as 48 by 96 inches.)

C. Determine the number of fractional units between last whole unit and second reference point

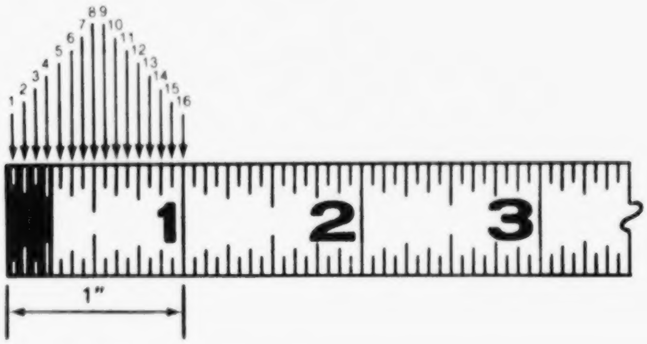
INFORMATION SHEET

1. Determine number of graduations per inch (Figure 11)

   (NOTE: At first you may have to count the number of divisions in an inch. However, with some practice, you will be able to recognize the divisions on sight and will eventually be able to determine fractional units just by looking at the rule.)

   EXAMPLE:

FIGURE 11

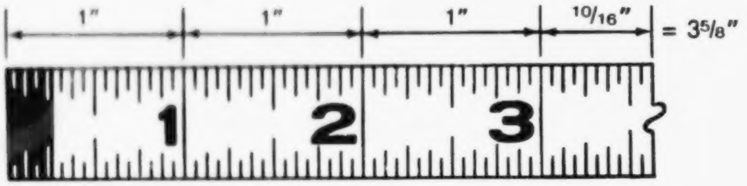


2. Determine the fractional part of an inch by counting the number of divisions between last inch and second reference point

3. Reduce the fraction if possible (Figure 12)

   EXAMPLE:

FIGURE 12



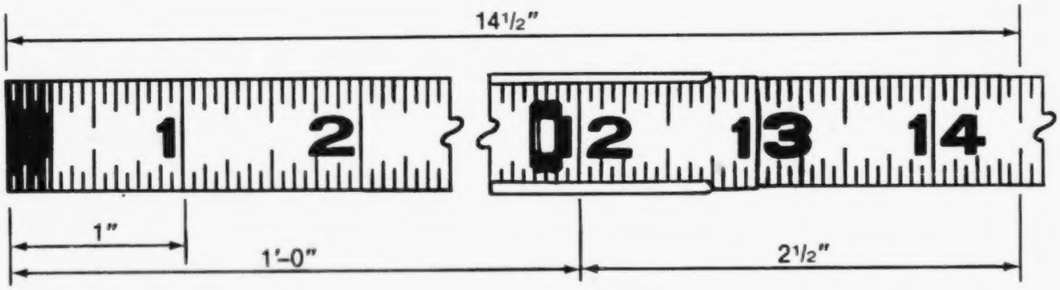
(NOTE: In the example above, the rule is divided into sixteenths. There are ten divisions between the last inch mark—3 inches—and the reference point. The $^{10}/_{16}$ can be reduced to $^{5}/_{8}$.)

INFORMATION SHEET

D. Determine the reading by adding fractional units to whole units and converting inches to feet or feet to inches if necessary (Figure 13)

EXAMPLE: The rule below shows a measurement of 1' – 2½" or 14½".

FIGURE 13



VI. Converting fractional inches to hundredths of a foot

(NOTE: There are two general methods used by the industry today for converting fractional inches to hundredths of a foot. One method is to apply the formula and rules described in this section. The formula is not exact, but it is generally accurate enough for the requirements of the construction worker and for use with the rules that a construction worker may have. The second method is to refer to a conversion table. See Table 1.)

A. Apply the following guidelines in the conversion process

1. Consider each 12 inches to be equal to 1.00 foot
2. Consider each 1/8 inch to be equal to 0.01 foot
3. To allow for the difference between 1/8 inch and 0.01 foot, add another 0.01 foot for 2 inches, 0.02 foot for 5 inches, 0.03 foot for 8 inches, and 0.04 foot for 11 inches

B. Use the following steps in the conversion process

1. Write the number of whole feet as a whole number to the left of the decimal point
2. Convert the remaining inches and fractional parts of inches to hundredths of a foot
   a. Change the inches and fractions to eighths, rounding sixteenths and thirty-seconds to the nearest eighth as necessary

INFORMATION SHEET

b. Multiply the numerator by 0.01

c. Add the product of the two numbers to the whole-foot number determined in Guideline A3

3. Add the required number for quantities of 2 inches or more as described in Step A3

EXAMPLE 1: Convert 14′ − 5$^{1}/_{4}$″ to hundredths of an inch.

a. 14′ = 14.00′

b. 5$^{1}/_{4}$″ = $^{21}/_{4}$″ = $^{42}/_{8}$″

c. 42 × 0.01 = 0.42

d. Add 0.02 for 5 inches

e.
$$\begin{array}{r} 14.00 \\ 0.42 \\ +\ 0.02 \\ \hline 14.44' \end{array}$$

EXAMPLE 2: Convert 5′ − $^{3}/_{16}$″ to hundredths of a foot.

a. 5′ = 5.00′

b. $^{3}/_{16}$″ = $^{1.5}/_{8}$″

c. $^{1.5}/_{8}$″ rounds to $^{2}/_{8}$″

d. 2 × 0.01 = 0.02

e.
$$\begin{array}{r} 5.00 \\ +0.02 \\ \hline 5.02' \end{array}$$

INFORMATION SHEET

EXAMPLE:

TABLE 1: Standard hundredths conversion

1/8″ = 0.01′
1/4″ = 0.02′
3/8″ = 0.03′
1/2″ = 0.04′
5/8″ = 0.05′
3/4″ = 0.06′
7/8″ = 0.07′

1″ = 0.08′
1 1/8″ = 0.09′
1 1/4″ = 0.10′
1 3/8″ = 0.11′
1 1/2″ = 0.12′
1 5/8″ = 0.13′
1 3/4″ = 0.14′
1 7/8″ = 0.15′

2″ = 0.16′ + 0.01′
= 0.17′
2 1/8″ = 0.18′
2 1/4″ = 0.19′
2 3/8″ = 0.20′
2 1/2″ = 0.21′
2 5/8″ = 0.22′
2 3/4″ = 0.23′
2 7/8″ = 0.24′
3″ = 0.25′

3 1/8″ = 0.26′
3 1/4″ = 0.27′
3 3/8″ = 0.28′
3 1/2″ = 0.29′
3 5/8″ = 0.30′
3 3/4″ = 0.31′
3 7/8″ = 0.32′

4″ = 0.33′
4 1/8″ = 0.34′
4 1/4″ = 0.35′
4 3/8″ = 0.36′
4 1/2″ = 0.37′
4 5/8″ = 0.38′
4 3/4″ = 0.39′
4 7/8″ = 0.40′

5″ = 0.41′ + 0.01′
= 0.42′
5 1/8″ = 0.43′
5 1/4″ = 0.44′
5 3/8″ = 0.45′
5 1/2″ = 0.46′
5 5/8″ = 0.47′
5 3/4″ = 0.48′
5 7/8″ = 0.49′
6″ = 0.50′

6 1/8″ = 0.51′
6 1/4″ = 0.52′
6 3/8″ = 0.53′
6 1/2″ = 0.54′
6 5/8″ = 0.55′
6 3/4″ = 0.56′
6 7/8″ = 0.57′

7″ = 0.58′
7 1/8″ = 0.59′
7 1/4″ = 0.60′
7 3/8″ = 0.61′
7 1/2″ = 0.62′
7 5/8″ = 0.63′
7 3/4″ = 0.64′
7 7/8″ = 0.65′

8″ = 0.66′ + 0.01′
= 0.67′
8 1/8″ = 0.68′
8 1/4″ = 0.69′
8 3/8″ = 0.70′
8 1/2″ = 0.71′
8 5/8″ = 0.72′
8 3/4″ = 0.73′
8 7/8″ = 0.74′
9″ = 0.75′

9 1/8″ = 0.76′
9 1/4″ = 0.77′
9 3/8″ = 0.78′
9 1/2″ = 0.79′
9 5/8″ = 0.80′
9 3/4″ = 0.81′
9 7/8″ = 0.82′

10″ = 0.83′
10 1/8″ = 0.84′
10 1/4″ = 0.85′
10 3/8″ = 0.86′
10 1/2″ = 0.87′
10 5/8″ = 0.88′
10 3/4″ = 0.89′
10 7/8″ = 0.90′

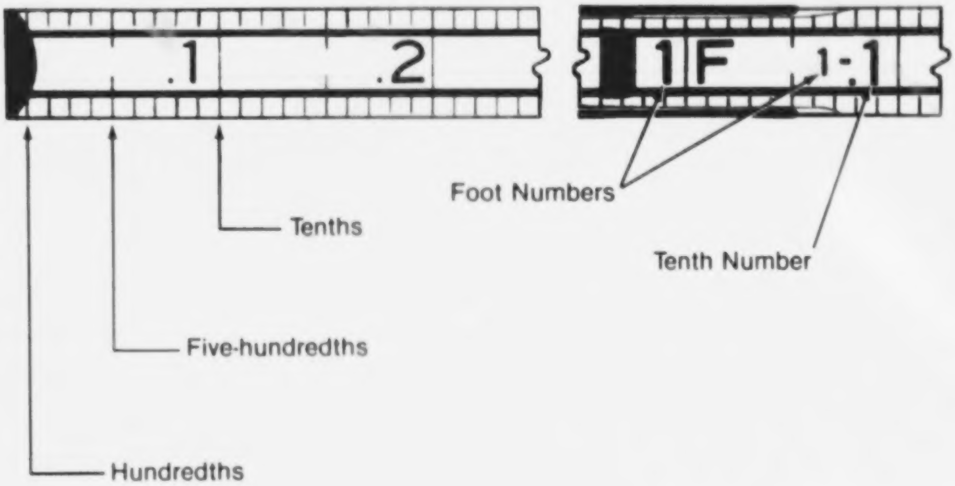
11″ = 0.91′ + 0.01′
= 0.92′
11 1/8″ = 0.93′
11 1/4″ = 0.94′
11 3/8″ = 0.95′
11 1/2″ = 0.96′
11 5/8″ = 0.97′
11 3/4″ = 0.98′
11 7/8″ = 0.99′
12″ = 1.00′

INFORMATION SHEET

VII. Graduations on an engineer's rule (Figure 14)

(NOTE: Many engineer's rules contain running-foot indicators.)

FIGURE 14



(NOTE: Ten 100ths equal $^{1}/_{10}$ of a foot. Two $^{5}/_{100\text{ths}}$ equal $^{1}/_{10}$ of a foot. Ten 10ths equal 1 foot. References to the other graduations on the engineer's rule are also common. For example, twenty-five hundredths [0.25] is the same as $^{1}/_{4}$ foot or 3 inches, and fifty hundredths [0.050] is the same as $^{1}/_{2}$ foot or 6 inches.)

VIII. Reading an engineer's rule to the nearest hundredth of a foot

A. Align end of the rule with one reference point

B. Determine the number of whole units between end of rule and second reference point

(NOTE: The units may be feet or tenths of a foot, depending on the distance measured and the use to be made of the measurement.)

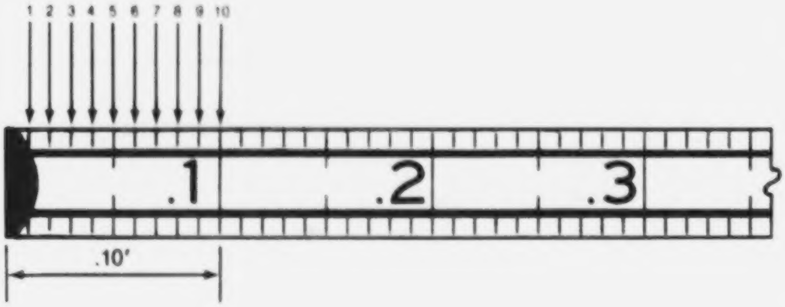
C. Determine the number of decimal units between last whole unit and second reference point

1. Determine the number of graduations per unit (See Figure 15)

INFORMATION SHEET

EXAMPLE: A rule marked off in tenths of a foot may have graduations for each tenth of a tenth or each hundredth of a foot.

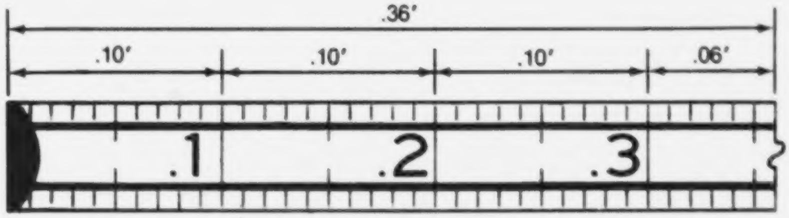
FIGURE 15



2. Count the number of hundredths between last full tenth and second reference point (Figure 16)

   EXAMPLE: The rule below shows a measurement of 36 hundredths of a foot, or 0.36′.

FIGURE 16

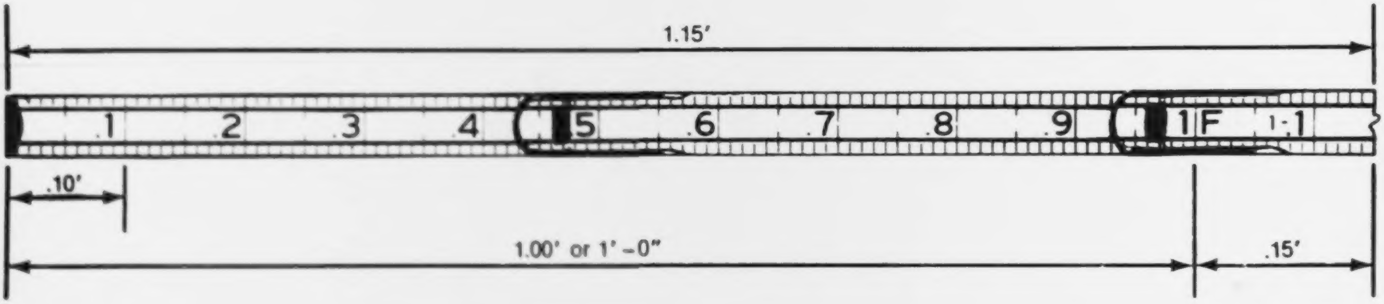


D. Determine the reading by adding decimal units to whole units and converting to feet and decimal parts of a foot if desired (See Figures 17 and 18)

INFORMATION SHEET

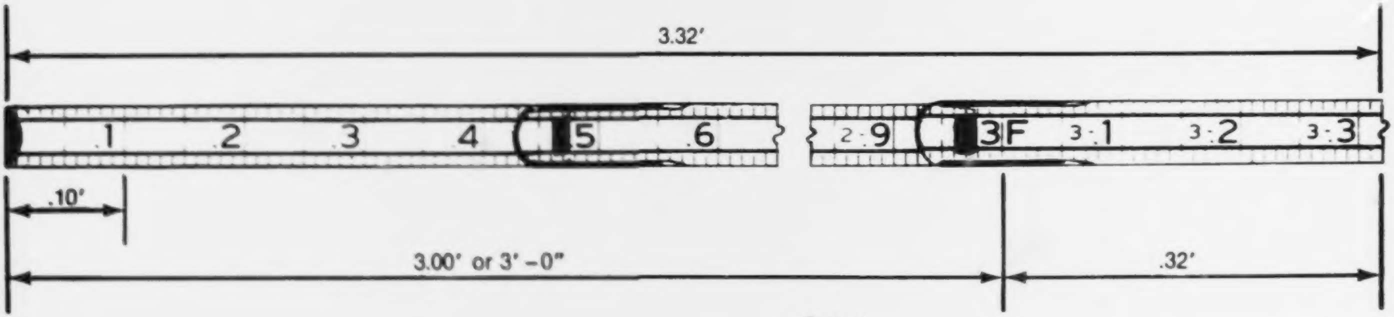
EXAMPLE 1: The rule below shows a measurement of 115 hundredths of a foot, or 1.15′.

FIGURE 17


1.15′
.1
.2
.3
.4
5
.6
.7
.8
.9
1F
1.1
.10′
1.00′ or 1′-0″
.15′

EXAMPLE 2: The rule below shows a measurement of 332 hundredths of a foot, or 3.32′.

FIGURE 18

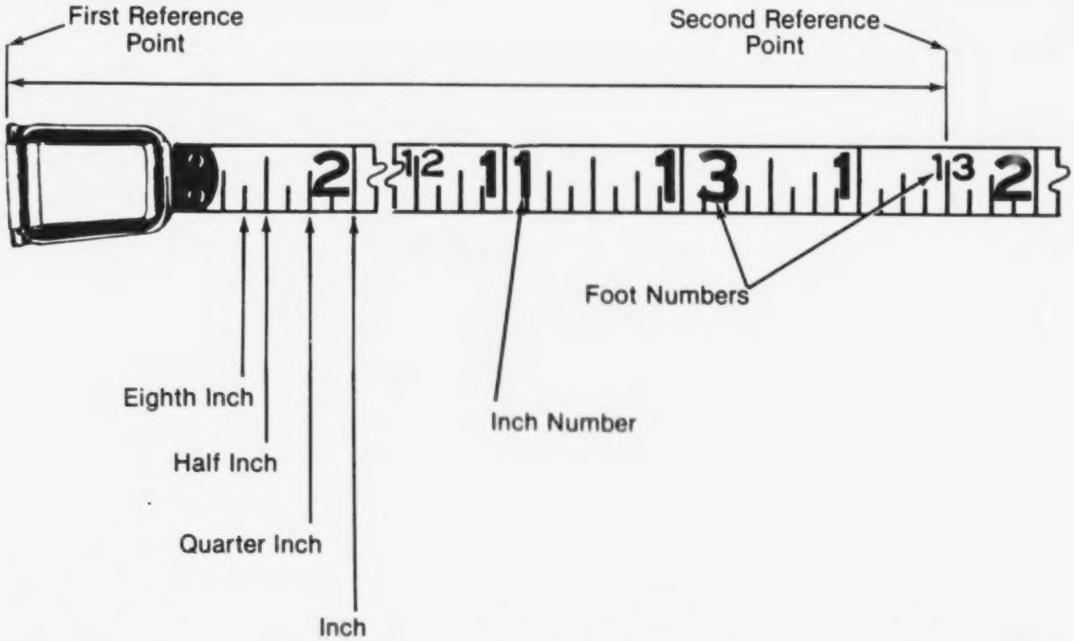

3.32′
.1
.2
.3
.4
5
.6
2.9
3F
3.1
3.2
3.3
.10′
3.00′ or 3′-0″
.32′

INFORMATION SHEET

IX. Graduations on a tape (Figure 19)

(NOTE: The graduations on tapes are the same as the various graduations on rules, but because tapes are used to measure long distances, most tapes contain running-foot indicators.)

FIGURE 19


First Reference Point
Second Reference Point
2
12
1
1
1
3
1
13
2
Foot Numbers
Eighth Inch
Half Inch
Quarter Inch
Inch
Inch Number

(NOTE: The tape in Figure 19 reads thirteen feet and one and one-half inches [13′ – 1½″] at the second reference point.)

X. Reading a tape to the nearest fraction of an inch

A. Place end of tape on one reference point

B. Reading from starting end of tape, determine number of feet to second reference point

C. Determine number of inches between last whole-foot mark and second reference point

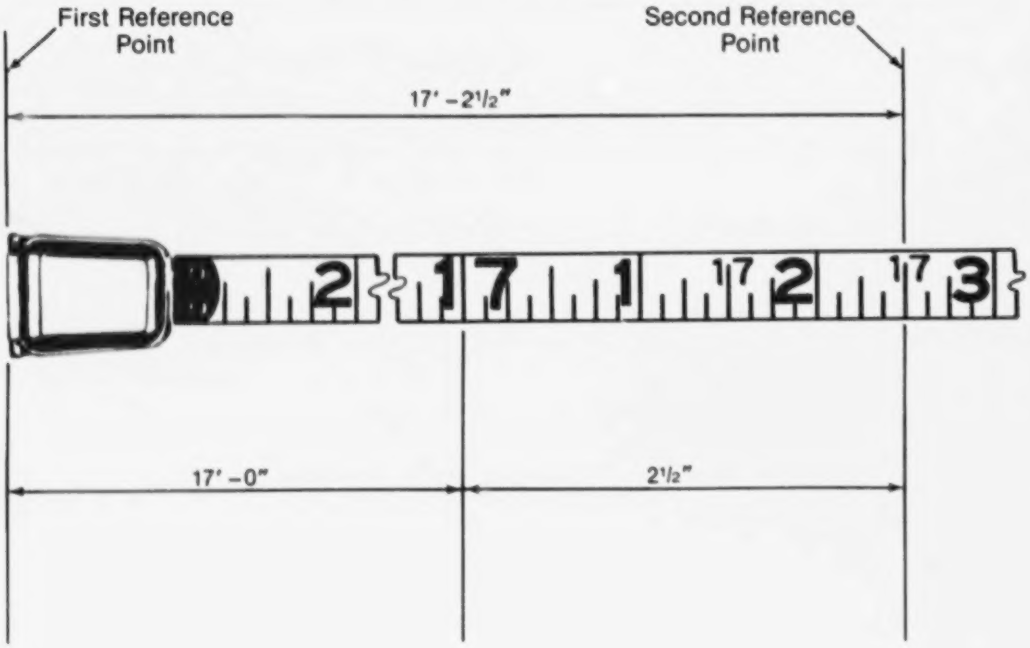
D. Determine fractional inches between last whole-inch mark and second reference point

INFORMATION SHEET

E. Add feet, inches, and fraction of an inch to obtain correct measurement (Figure 20)

EXAMPLE: The tape below reads seventeen feet two and one-half inches (17′ −2½″) at the second reference point.

FIGURE 20


First Reference Point
Second Reference Point
17′ −2½″
2
17
1
17
2
17
3
17′ −0″
2½″

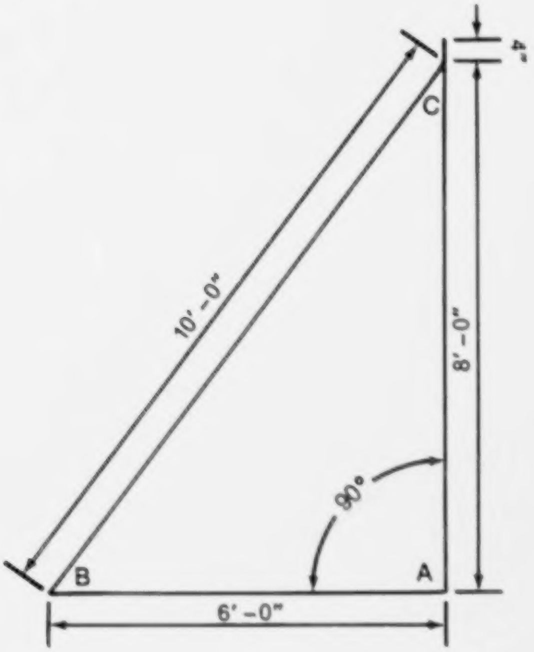
XI. Measuring methods used to square lines

A. 3-4-5 method — Forming a right triangle using largest multiple of 3-4-5 feet (6-8-10, 12-16-20, 24-32-40, etc.) possible for length of lines being squared, and ensuring that longest side of triangle is exact appropriate multiple of 5 (See Figure 21)

INFORMATION SHEET

EXAMPLE: Use the 3-4-5 method to square form corners.

FIGURE 21



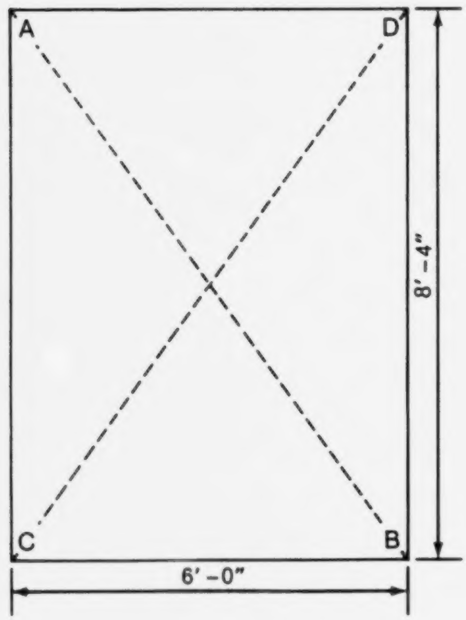
1. Measure 6 feet from Point A to Point B; mark
2. Measure 8 feet from Point A to Point C; mark
3. Measure from Point B to Point C
4. If the lines are square, measurement from Point B to Point C will be exactly 10 feet; if the measurement is not exactly 10 feet, adjust one of the lines

B. Diagonal method — Measuring diagonally from inside corners of layout and ensuring that diagonal lines are equal in length (See Figure 22)

INFORMATION SHEET

EXAMPLE: Use the diagonal method to square form corners.

FIGURE 22



1. Measure diagonally from Point A to Point B
2. Record this measurement
3. Measure diagonally from Point C to Point D
4. Record this measurement
5. If lines are square, both diagonal measurements (AB and CD) will be exactly the same; if they are not exactly the same, adjust one of the lines

MEASURING
UNIT III

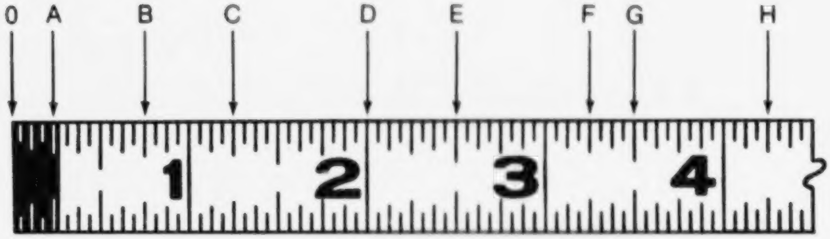
ASSIGNMENT SHEET #1 — READ MEASUREMENTS ON FOLDING AND ENGINEER'S RULES

NAME ______________________________ SCORE ______________

The first step in being able to make accurate measurements is to become familiar with the graduations on rules and how to read them. This assignment sheet will allow you to practice reading measurements on rules.

PART I

A. Read the folding rule illustrated below to the nearest quarter inch. Write your answers on the lines provided.



1. 0 to A = ______________

2. A to B = ______________

3. 0 to C = ______________

4. A to D = ______________

5. B to D = ______________

6. 0 to E = ______________

7. C to E = ______________

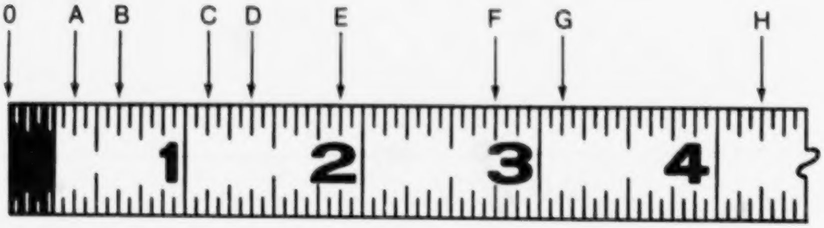
8. B to F = ______________

9. D to G = ______________

10. A to H = ______________

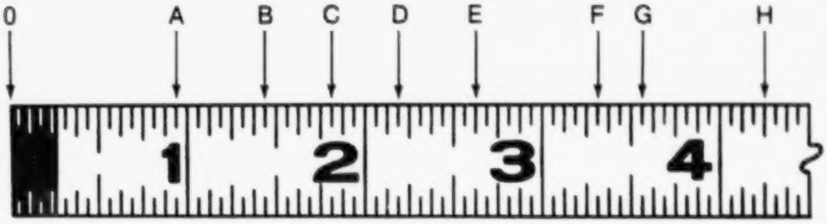
ASSIGNMENT SHEET #1

B. Read the folding rule illustrated below to the nearest eighth inch. Write your answers on the lines provided.



1. 0 to A = ______________________
2. A to B = ______________________
3. 0 to C = ______________________
4. B to D = ______________________
5. A to E = ______________________
6. 0 to F = ______________________
7. D to F = ______________________
8. C to G = ______________________
9. A to H = ______________________
10. E to H = ______________________

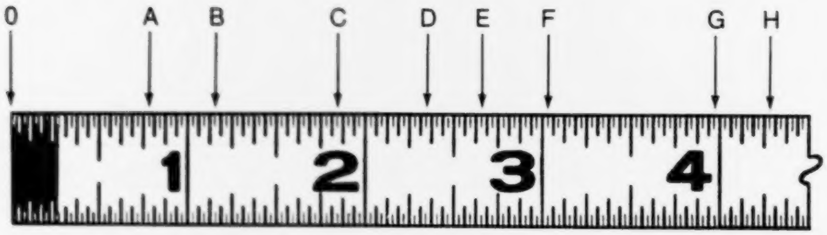
C. Read the folding rule illustrated below to the nearest sixteenth inch. Write your answers on the lines provided.



1. 0 to A = ______________________
2. A to B = ______________________
3. 0 to C = ______________________
4. B to D = ______________________
5. A to E = ______________________
6. 0 to F = ______________________
7. C to F = ______________________
8. A to G = ______________________
9. 0 to H = ______________________
10. E to H = ______________________

ASSIGNMENT SHEET #1

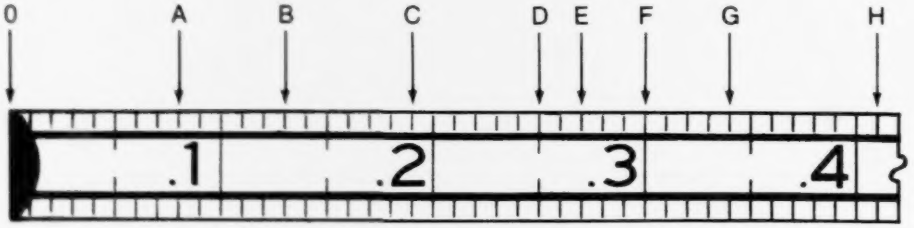
D. Read the folding rule illustrated below to the nearest one-thirty-seconds of an inch. Write your answers on the lines provided.



1. 0 to A = ____________________
2. 0 to B = ____________________
3. A to B = ____________________
4. 0 to C = ____________________
5. A to D = ____________________
6. B to E = ____________________
7. C to F = ____________________
8. B to G = ____________________
9. 0 to H = ____________________
10. D to H = ____________________

PART II

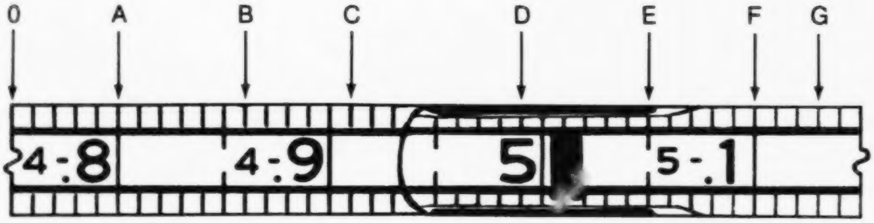
A. Read the engineer's rule illustrated below to the nearest hundredth of a foot. Write your answers on the lines provided.



1. 0 to A = ____________________
2. A to B = ____________________
3. 0 to C = ____________________
4. B to E = ____________________
5. 0 to D = ____________________
6. C to F = ____________________
7. D to G = ____________________
8. 0 to F = ____________________
9. E to H = ____________________
10. 0 to H = ____________________

ASSIGNMENT SHEET #1

B. Read the engineer's rule illustrated below to the nearest hundredth of a foot. Write your answers on the lines provided.



1. A = ______________________
2. B = ______________________
3. C = ______________________
4. D = ______________________
5. E = ______________________
6. F = ______________________
7. G = ______________________
8. A to D = ______________________
9. B to F = ______________________
10. C to G = ______________________

MEASURING
UNIT III

ASSIGNMENT SHEET #2 — MEASURE OBJECTS

NAME ______________________________ SCORE ______________

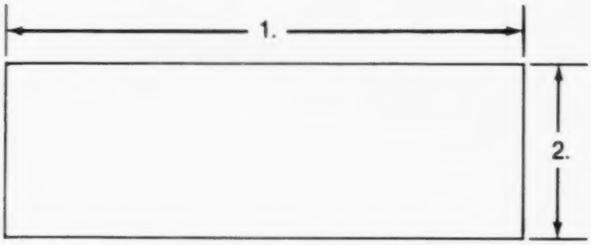
To build forms accurately, the construction worker must be able to measure correctly form boards, openings, and distances. They must be able to fit forms and other parts that must be the right size and shape for proper forming. A construction worker will use measuring skills in various phases of construction; thus, it is essential for construction workers to master the ability to measure.

PART I

Measure the following objects, using a rule graduated in sixteenths of an inch. Write your answers in the blanks.

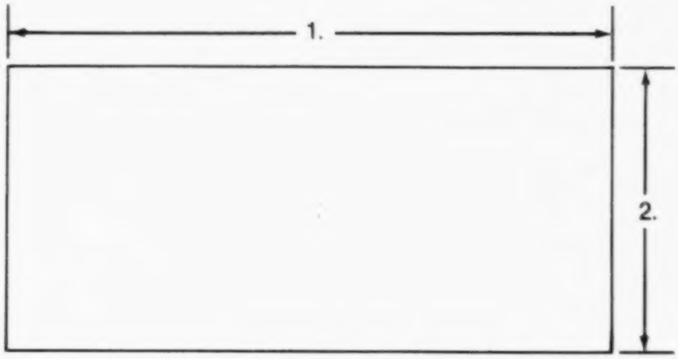
A. 1. Length = ______________

2. Height = ______________



B. 1. Length = ______________

2. Height = ______________

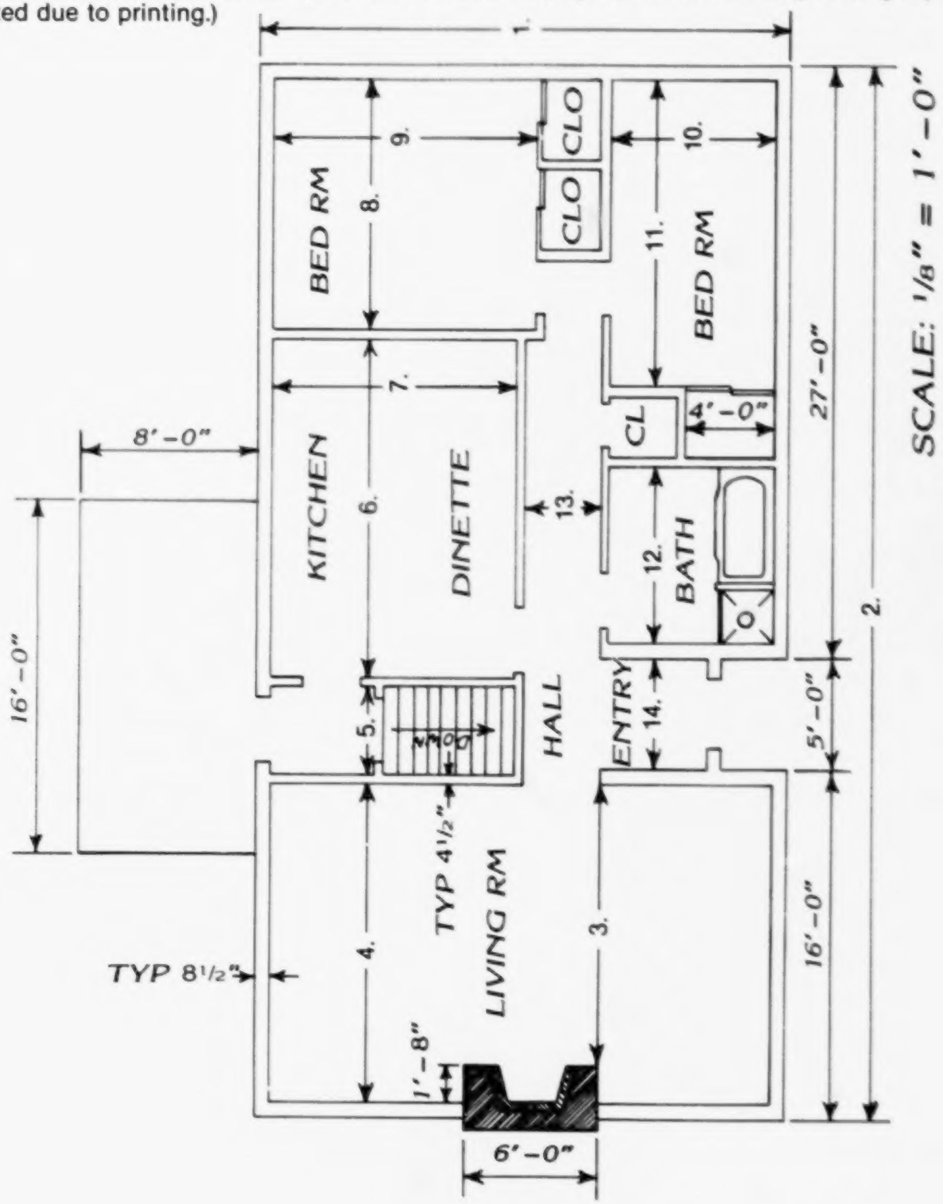


ASSIGNMENT SHEET #2

PART II

Because of the size of most construction projects, it is usually necessary to make *scale drawings* of houses, buildings, cabinets, etc. A scale drawing uses one dimension to represent another, and all dimensions on the drawing are reduced in the same proportion. For example, using a scale in which 1 inch on the drawing is equal to 1 foot on the actual object 4 feet high and 5 feet long, the drawing would be 4 inches by 5 inches.

A. Using a scale of 1/8 inch equals 1 foot, determine the dimensions represented on this plan. Write your answers in the blanks provided on the next page. (Dimensions may be slightly distorted due to printing.)



1.
9.
CLO
CLO
10.
BED RM
8.
11.
BED RM
27'-0"
SCALE: 1/8" = 1'-0"
7.
8'-0"
CL
4'-0"
KITCHEN
6.
DINETTE
13.
12.
BATH
2.
16'-0"
5.
DOWN
HALL
ENTRY
14.
5'-0"
TYP 4 1/2"
LIVING RM
3.
4.
TYP 8 1/2"
16'-0"
1'-8"
6'-0"

ASSIGNMENT SHEET #2

1. = ______________________________
2. = ______________________________
3. = ______________________________
4. = ______________________________
5. = ______________________________
6. = ______________________________
7. = ______________________________
8. = ______________________________
9. = ______________________________
10. = ______________________________
11. = ______________________________
12. = ______________________________
13. = ______________________________
14. = ______________________________

B. Your instructor will indicate objects and structures in your shop area for you to measure. Measure the objects and write down the dimensions. Beside the dimensions, write the length that a line for that dimension would be on a drawing with a scale of 1/4 inch equals 1 foot.

MEASURING
UNIT III

ASSIGNMENT SHEET #3 — CONVERT FRACTIONAL INCHES TO HUNDREDTHS OF A FOOT

NAME ______________________________ SCORE ______________

Many rules are marked in hundredths of a foot. Often the construction worker is required to convert inch dimensions to decimal fractions of a foot. This exercise will help you become more proficient at converting fractional inches to hundredths of a foot.

Using the three guidelines below, convert the following inch dimensions to hundredths of a foot. Show your work.

- Consider each 12 inches to be equal to 1.00 foot
- Consider each $\frac{1}{8}$ inch to be equal to 0.01 foot
- Add 0.01 foot for 2 inches, 0.02 foot for 5 inches, 0.03 foot for 8 inches, and 0.04 foot for 11 inches

EXAMPLE: Convert $6' - 4\frac{1}{8}''$ to hundredths of a foot.

a. $6' = 6.00$

b. $4\frac{1}{8}'' = \frac{33}{8} = 0.33$

c. Add 0.01

d.
$$\begin{array}{r} 6.00 \\ 0.33 \\ +0.01 \\ \hline 6.34' \end{array}$$

A. $\frac{1}{4}'' =$ ______________________

B. $14' - 5\frac{1}{2}'' =$ ______________________

C. $\frac{3}{4}'' =$ ______________________

D. $6\frac{5}{8}'' =$ ______________________

ASSIGNMENT SHEET #3

E. $1^{3}/_{8}$" = ____________________   F. $7' - 7^{1}/_{8}$" = ____________________

G. $2\ ^{7}/_{8}$" = ____________________   H. 2' – 8" = ____________________

I. 4" = ____________________   J. $11\ ^{3}/_{8}$" = ____________________

MEASURING
UNIT III

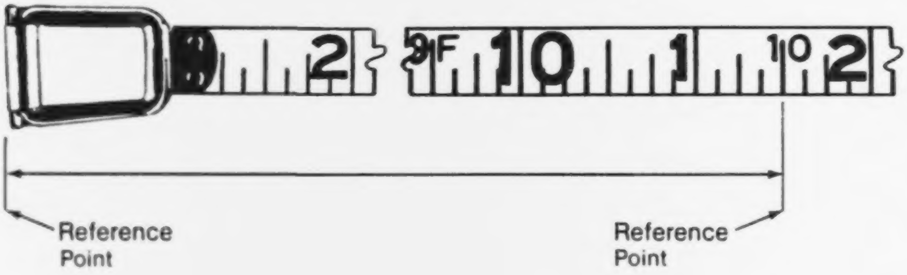
ASSIGNMENT SHEET #4 — READ MEASUREMENTS ON TAPES

NAME ______________________________ SCORE ______________

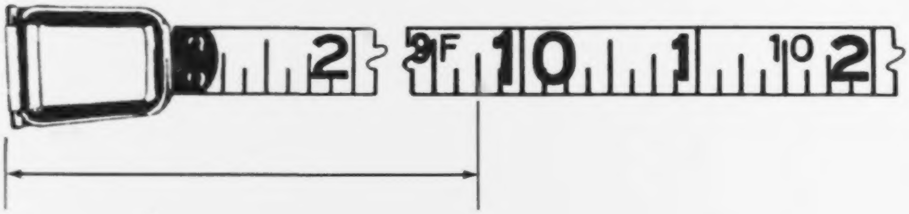
This exercise will give you experience reading a tape and will help you to read a tape quickly and efficiently.

Using the procedures outlined in Section X of the information sheet, read the following tapes. Write the correct dimensions on the lines between the reference points.

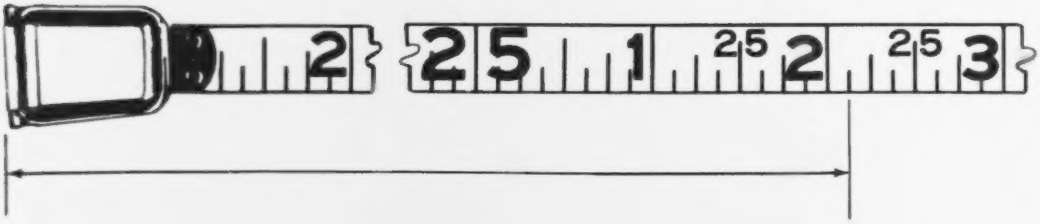
A.


2
3F
10
1
10
2
Reference Point
Reference Point

B.

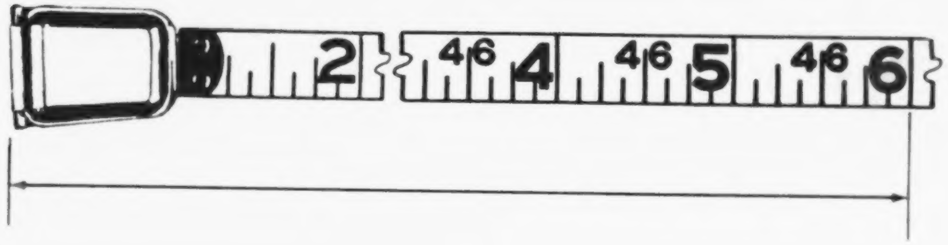


C.

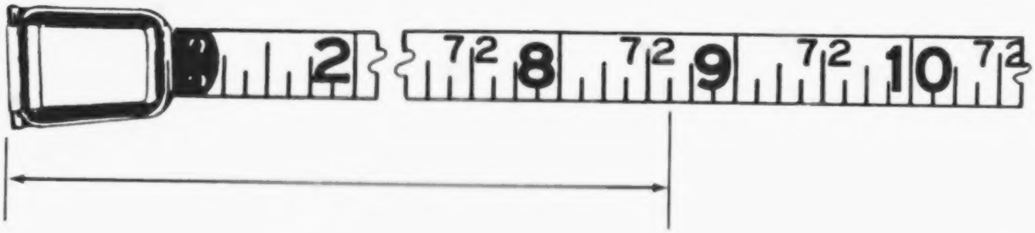

2
25
1
25
2
25
3

ASSIGNMENT SHEET #4

D.


2
4
6
4
4
6
5
4
6
6

E.


2
7
2
8
7
2
9
7
2
10
7
2

MEASURING
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

PART I

A. 1. 1/4″
2. 1/2″
3. 1 1/4″
4. 1 3/4″
5. 1 1/4″
6. 2 1/2″
7. 1 1/4″
8. 2 1/2″
9. 1 1/2″
10. 4″

B. 1. 3/8″
2. 1/4″
3. 1 1/8″
4. 3/4″
5. 1 1/2″
6. 2 3/4″
7. 1 3/8″
8. 2″
9. 3 7/8″
10. 2 3/8″

C. 1. 15/16″
2. 1/2″
3. 1 13/16″
4. 3/4″
5. 1 11/16″
6. 3 5/16″
7. 1 1/2″
8. 2 5/8″
9. 4 1/4″
10. 1 5/8″

D. 1. 25/32″
2. 1 5/32″
3. 3/8″
4. 1 27/32″
5. 1 9/16″
6. 1 1/2″
7. 1 3/16″
8. 2 13/16″
9. 4 9/32″
10. 1 15/16″

PART II

A. 1. 0.08′
2. 0.05′
3. 0.19′
4. 0.14′
5. 0.25′
6. 0.11′
7. 0.09′
8. 0.30′
9. 0.14′
10. 0.41′

B. 1. 4.80′
2. 4.86′
3. 4.91′
4. 4.99′
5. 5.05′
6. 5.10′
7. 5.13′
8. 0.19′
9. 0.24′
10. 0.22′

Assignment Sheet #2

PART I

A. 1. 2 15/16″
2. 1″

B. 1. 3 7/16″
2. 1 5/8″

PART II

A. 1. 24′-0″
2. 48′-0″
3. 12′-10″
4. 14′-6″
5. 4′-0″
6. 15′-6″
7. 11′-0″
8. 11′-6″
9. 12′-0″
10. 7′-6″
11. 14′-0″
12. 8′-0″
13. 3′-6″
14. 5′-0″

B. Evaluated to the satisfaction of the instructor

Assignment Sheet #3

A. 0.02′
B. 14.46′
C. 0.06′
D. 0.55′
E. 0.11′
F. 7.59′
G. 0.24′
H. 2.67′
I. 0.33′
J. 0.95′

Assignment Sheet #4

A. 10′-1 1/2″
B. 9′-11 3/4″
C. 25′-2 1/8″
D. 46′-6″
E. 72′-8 5/8″

MEASURING
UNIT III

JOB SHEET #1 — USE BASIC MEASURING TOOLS AND THE 3-4-5 METHOD TO LAY OUT THE PERIMETER OF A BUILDING ON A CONCRETE SLAB

I. Equipment and materials

- A. Floor plan at end of job sheet (See Figure 28)
- B. Two 50-foot or 100-foot tapes
- C. Chalk line
- D. Pencil
- E. Keel

II. Procedure

(NOTE: Reference Point A on concrete slab will be designated by the instructor.)

A. Establish point for south wall (Point B, Figure 23)

1. Have an assistant hold one end of a tape exactly on Point A (southwest corner of the building)

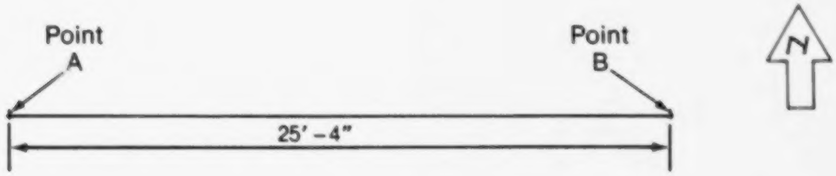
2. From Point A, stretch tape for south wall to approximately 26 feet; mark on concrete at exactly 25 feet 4 inches (Point B)

   (NOTE: Use keel to circle this and all marks so that they will be easy to identify.)

3. Snap a line from Point A to Point B with chalk line

   (NOTE: Be sure to keep the chalk line taut so that the line will be straight.)

FIGURE 23



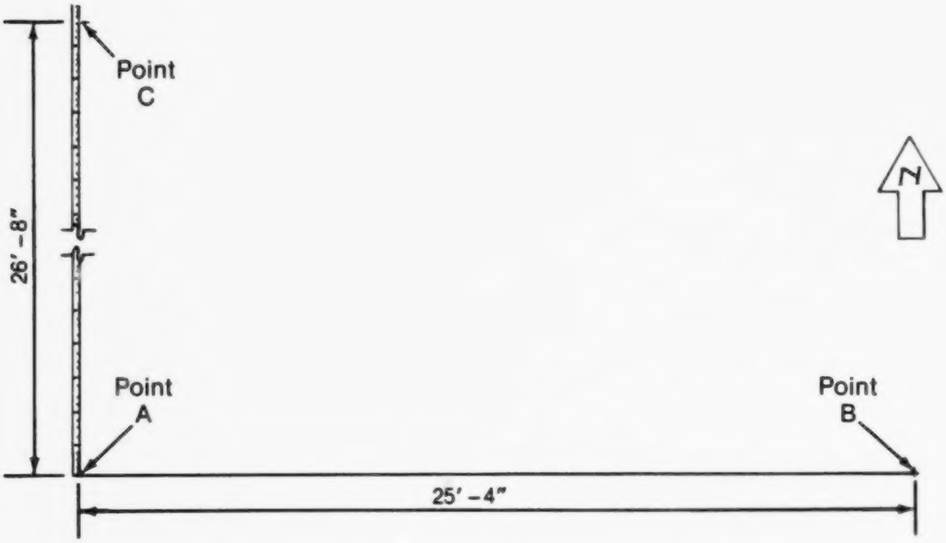
JOB SHEET #1

B. Establish point for west wall (Point C, Figure 24)

1. Have an assistant hold end of a tape exactly on Point A

2. Stretch tape for west wall to approximately 27 feet; mark on concrete at exactly 26 feet 8 inches (Point C)

FIGURE 24



C. Before snapping chalk line for the west wall (Line AC), use the 3-4-5 method to ensure that the line for this wall will be perpendicular to Line AB (See Figure 25)

(NOTE: In this particular project, the multiples of 18-24-30 are used.)

1. Starting at Point A, measure to exactly 24 feet on Line AB; mark this point on the concrete

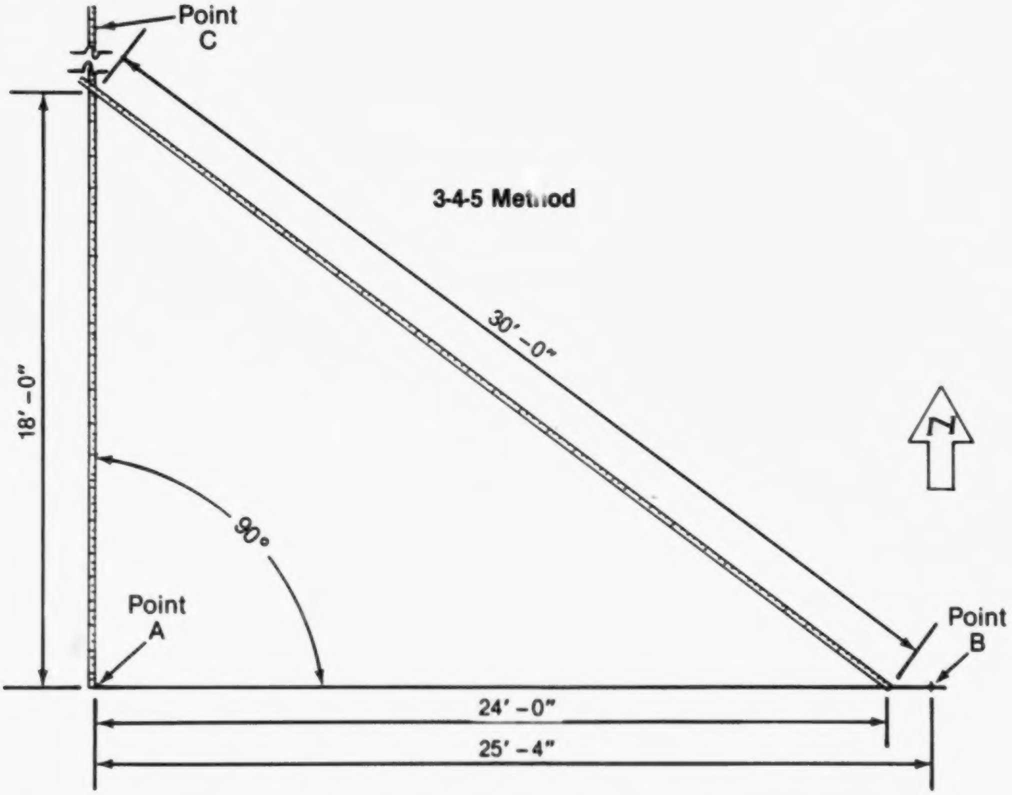
2. Have an assistant place end of one tape exactly on Point A; keeping tape at a right angle to Line AB, stretch tape to 18 feet

3. Have another assistant place end of a second tape exactly on the 24-foot mark on Line AB; pull second tape, at an angle, from the 24-foot mark on Line AB to the 18-foot graduation on the first tape

JOB SHEET #1

4. Adjust the two tapes until the 30-foot graduation on the second tape crosses the 18-foot graduation on the first tape; mark this point on the concrete and remove both tapes

FIGURE 25



D. Snap a line from Point A to Point C with chalk line, making sure that line passes directly through point where 18-foot and 30-foot measurements crossed

E. Establish point for east and north walls (Point D) (See Figure 26)

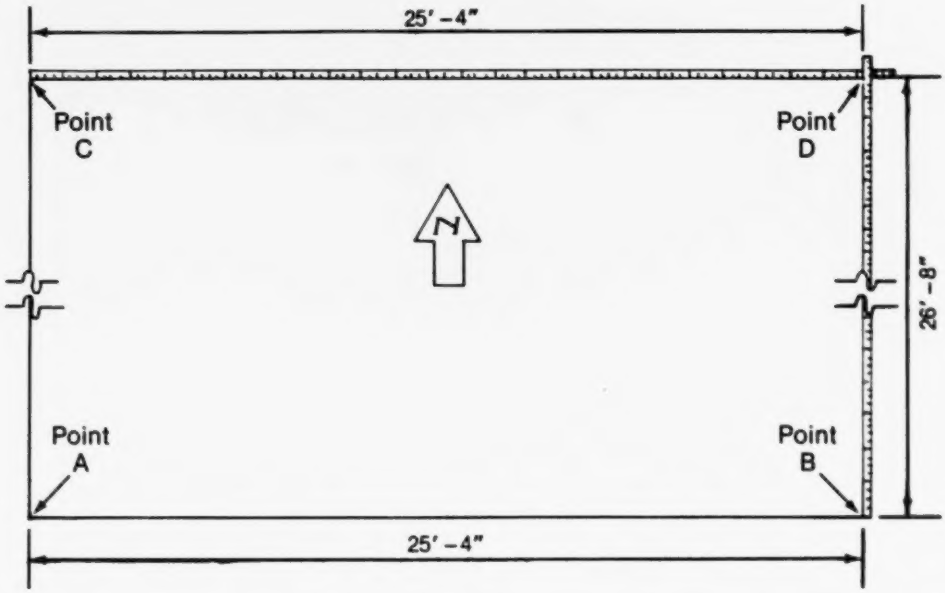
   1. Have an assistant place end of one tape exactly on Point B; stretch tape for east wall to 26 feet 8 inches (Point D)

   2. Have another assistant place end of a second tape exactly on Point C; stretch tape for north wall to 25 feet 4 inches (Point D)

   3. Adjust tapes until 26-foot 8-inch graduation on the first tape crosses the 25-foot 4-inch graduation on the second tape; mark this point (Point D) on the concrete and remove both tapes

JOB SHEET #1

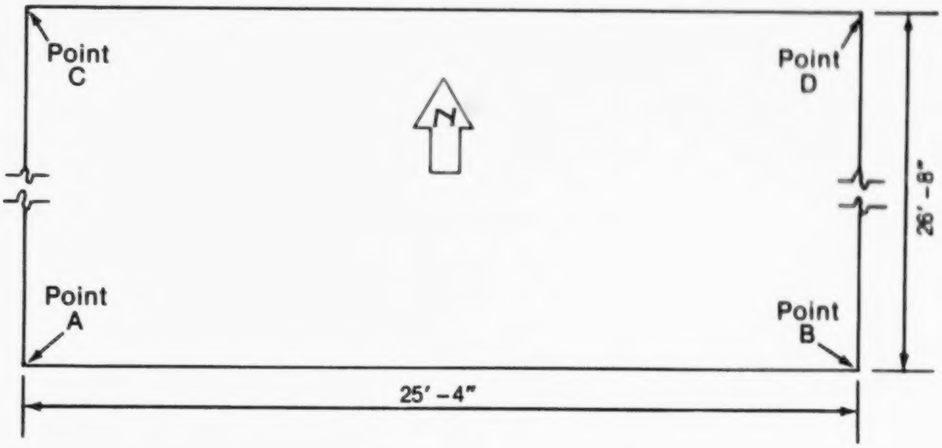
FIGURE 26


25' – 4"
Point C
Point D
N
26' – 8"
Point A
Point B
25' – 4"

F. Snap lines from Points C to D and B to D with chalk line

(NOTE: You have now established the perimeter of the building. See Figure 27.)

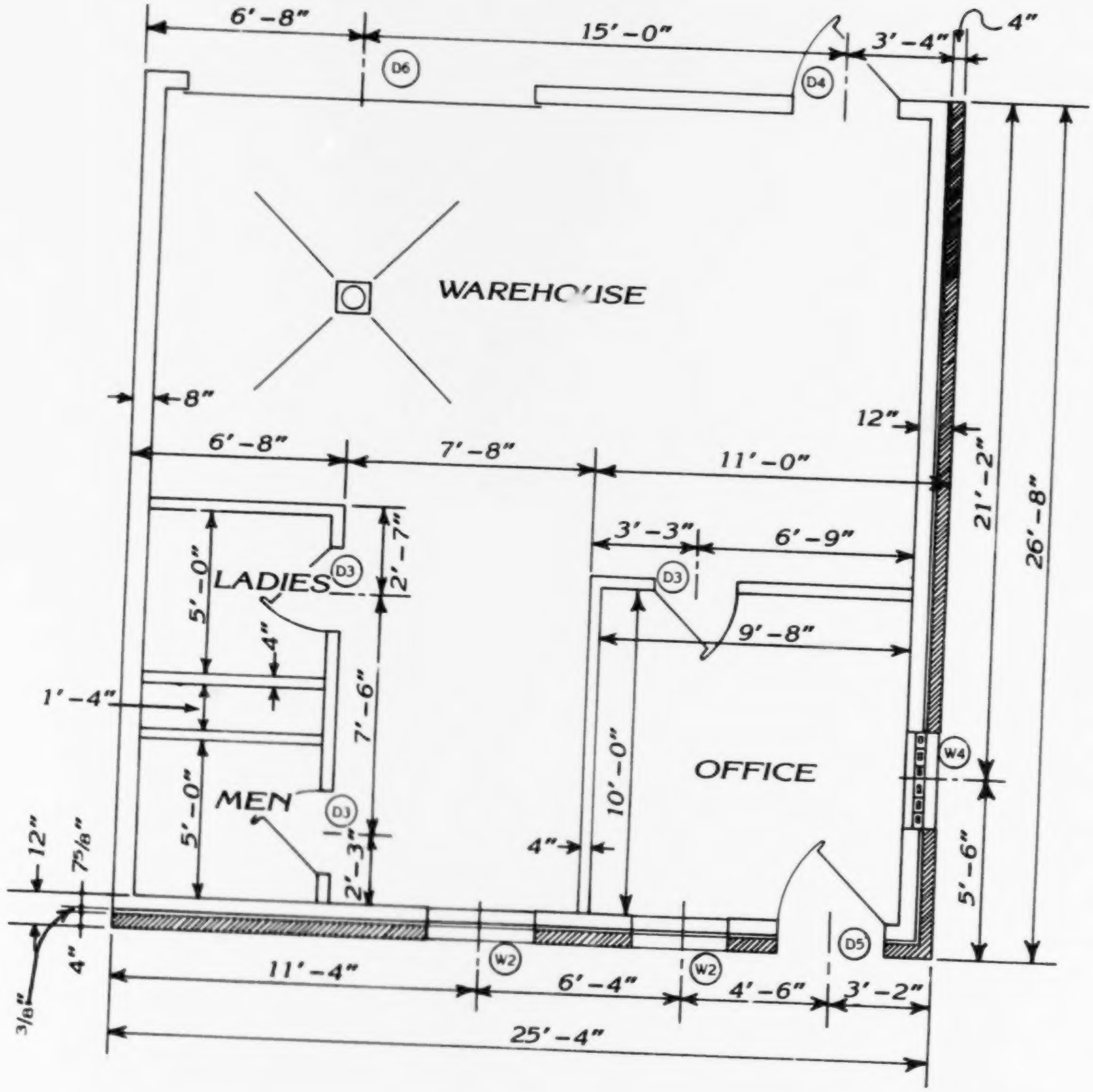
FIGURE 27


Point C
Point D
N
26' – 8"
Point A
Point B
25' – 4"

G. Clean up work area and put away equipment and materials, or measure and lay out inside dimensions shown on floor plan as directed by your instructor

JOB SHEET #1

FIGURE 28


6'-8"
15'-0"
3'-4"
4"
D6
D4
WAREHOUSE
8"
12"
6'-8"
7'-8"
11'-0"
21'-2"
26'-8"
3'-3"
6'-9"
2'-7"
5'-0"
LADIES
D3
D3
9'-8"
4"
1'-4"
7'-6"
10'-0"
OFFICE
W4
MEN
D3
5'-0"
12"
7⅝"
4"
2'-3"
5'-6"
4"
3/8"
W2
W2
D5
11'-4"
6'-4"
4'-6"
3'-2"
25'-4"

FLOOR PLAN

SCALE: 3/16" = 1'-0"

MEASURING
UNIT III

TEST

NAME ______________________________ SCORE ______________

1. Match terms and definitions associated with measuring. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a. Arrangement of lines to indicate the actual size for constructing the object or structure represented
    1. Measures
    2. Dimensions
    3. Divisions

_____b. Parts or sections that make up 1 inch on a rule
    1. Divisions
    2. Fractions
    3. Graduations

_____c. Unit of measure consisting of twelve equal parts called *inches*
    1. Foot
    2. Inch
    3. Rule

_____d. Part of a whole; represents one or more equal parts of a unit
    1. Graduation
    2. Fraction
    3. Division

_____e. Smallest whole unit of lineal measure commonly used
    1. Inch
    2. Fraction
    3. Foot

_____f. Type of colored marking crayon used in construction
    1. Pencil
    2. Felt-tip pen
    3. Keel

_____g. Plan or design of the project to be constructed
    1. Perimeter
    2. Layout
    3. Division

_____h. Relating to, consisting of, or resembling a straight line
    1. Taut
    2. Lineal
    3. Layout

TEST

______i. Setting of limits or bounds according to a predetermined standard
1. Measuring
2. Graduating
3. Dividing

______j. Outer limits or boundaries
1. Layout
2. Line
3. Perimeter

______k. Measuring instrument graduated in whole units and fractions of units
1. Rule
2. Keel
3. Foot

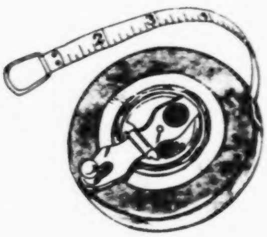
______l. Tightly stretched; not slack
1. Level
2. Taut
3. Plumb

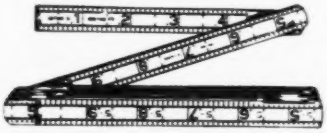
______m. Marks on a rule or tape indicating measurements
1. Divisions
2. Dimensions
3. Graduations

---

2. Identify the following basic measuring tools used by construction workers. Write the correct names in the blanks.

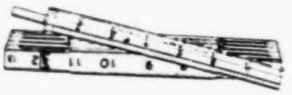
Sixteen-foot
One-hundred-foot steel tape
Spring-balanced tape-tension handle
Triangular rafter square
Engineer's folding rule
Steel framing square
Folding rule
Combination square
Two-hundred-foot steel tape and reel

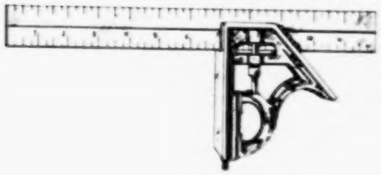




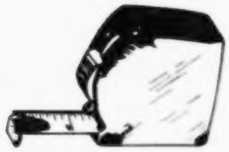
a. ______________________ b. ______________________

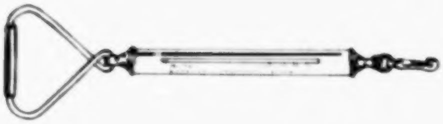
TEST



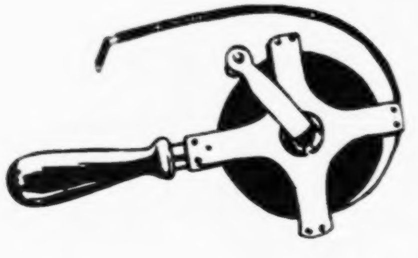


c. ______________________________ d. ______________________________



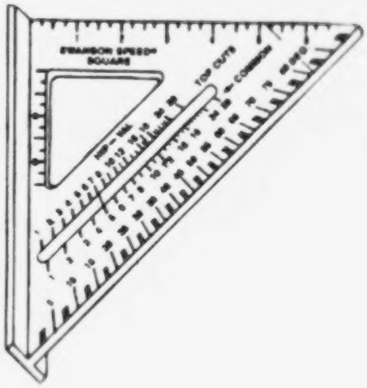


e. ______________________________ f. ______________________________

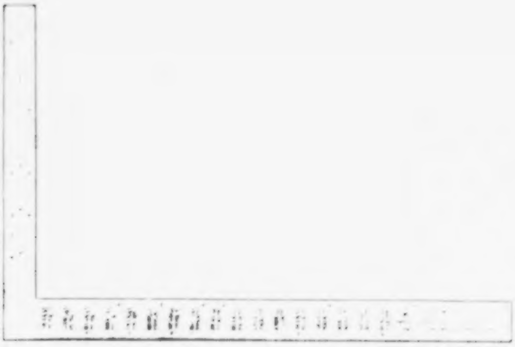


g. ______________________________

TEST



h. ______________________________



i. ______________________________

3. List five common errors that contribute to incorrect measurements.

   a. ______________________________

   b. ______________________________

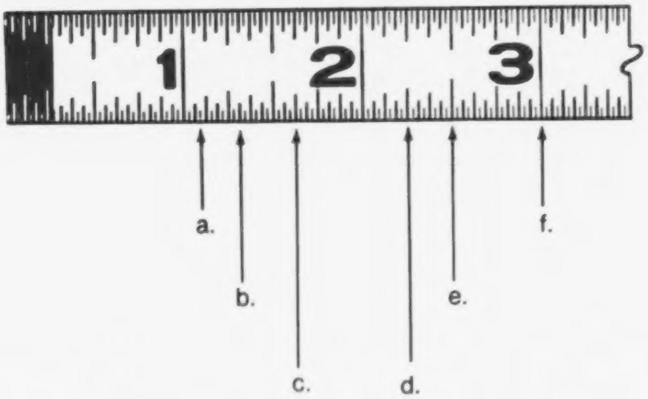
   c. ______________________________

   d. ______________________________

   e. ______________________________

TEST

4. Identify graduations on the folding rule illustrated below. Write the correct names in the blanks.



a. ______________________

b. ______________________

c. ______________________

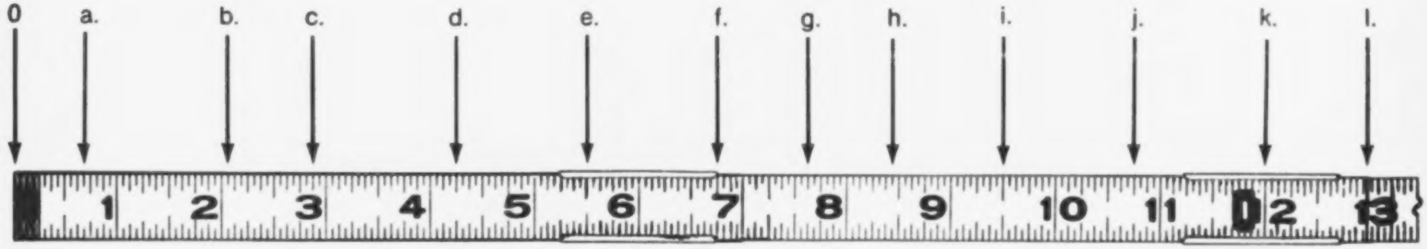
d. ______________________

e. ______________________

f. ______________________

TEST

5. Read the folding rule illustrated below to the nearest fraction of an inch. Answer as if the rule were shown full size. Start each reading from the 0 end of the rule. Write the correct graduations in the corresponding blanks.


0
a.
b.
c.
d.
e.
f.
g.
h.
i.
j.
k.
l.
1
2
3
4
5
6
7
8
9
10
11
12
13

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

k. ______________________________

l. ______________________________

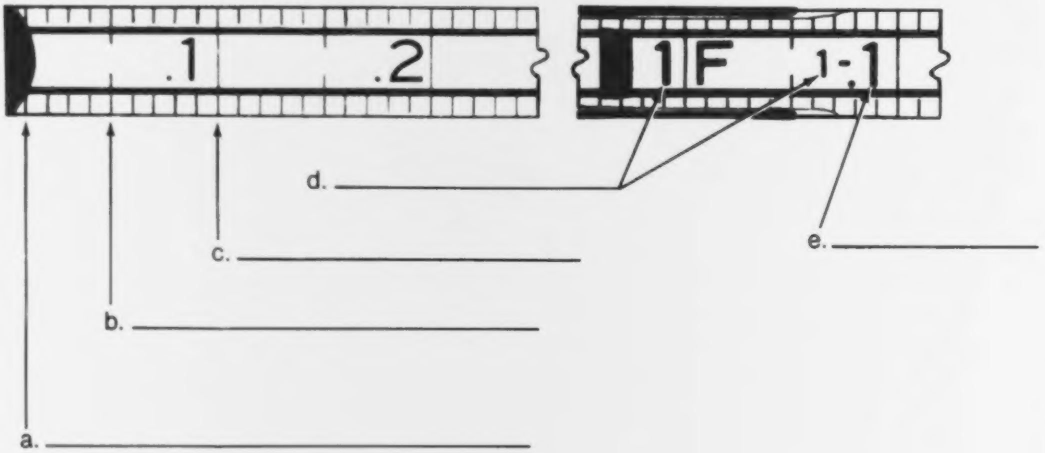
TEST

6. Convert the following fractional inches to hundredths of a foot. Write the correct answers in the blanks. Show your work.

__________a. 1/8" __________b. 1 7/8" __________c. 6 5/8"

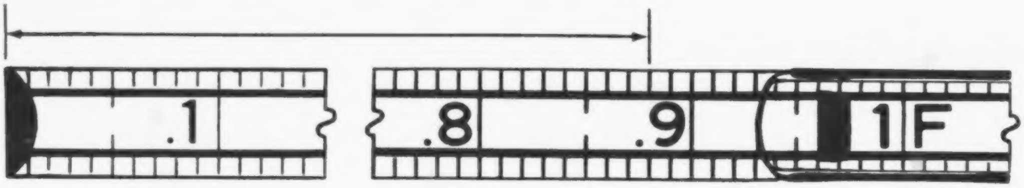
__________d. 1" __________e. 2 3/8" __________f. 11 1/2"

7. Identify graduations on the engineer's rule illustrated below. Write the correct names in the blanks.

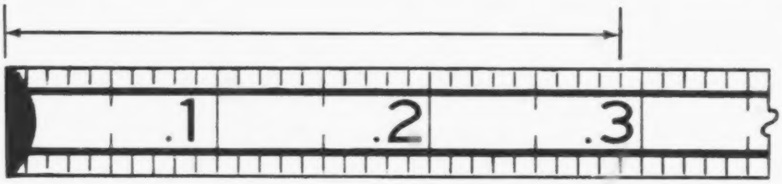


TEST

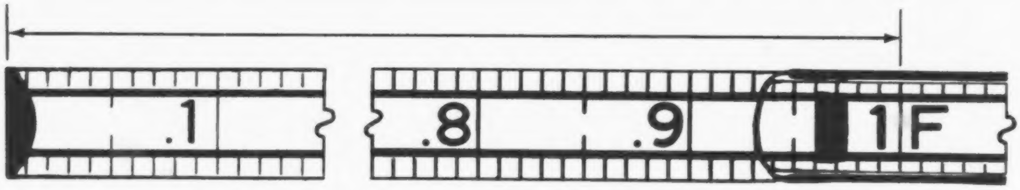
8. Read the engineer's rules illustrated below to the nearest hundredths of a foot. Write the correct answers in the blanks.



a. ____________________

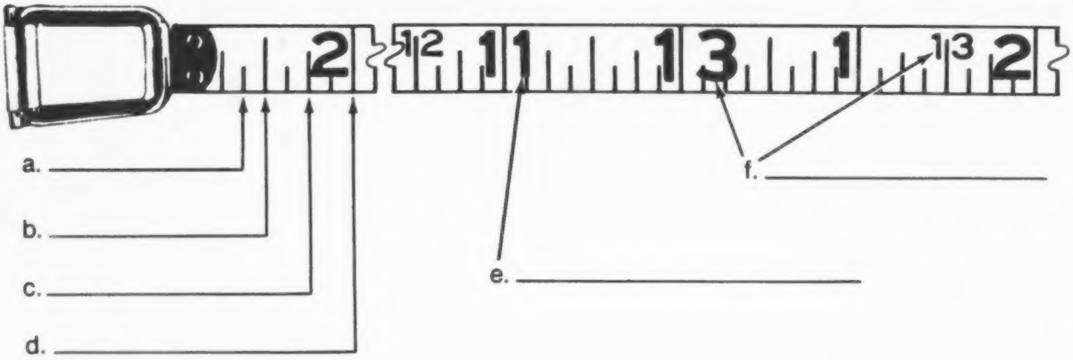


b. ____________________



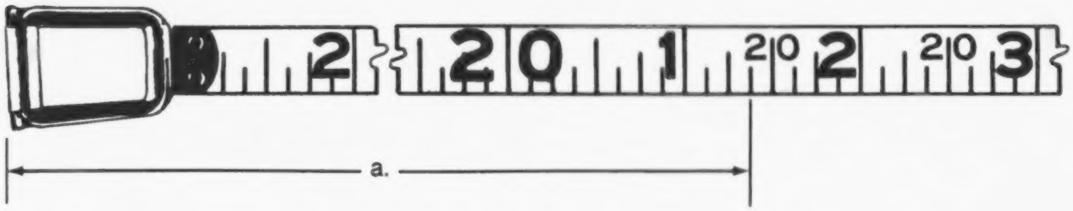
c. ____________________

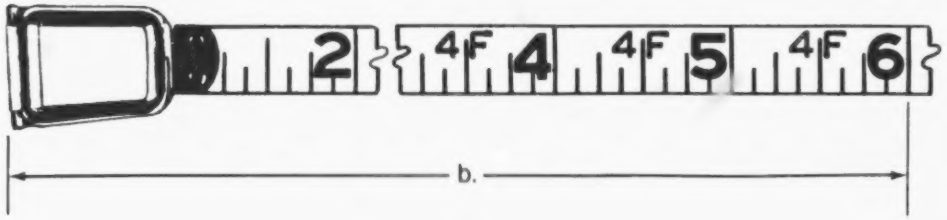
9. Identify graduations on the tape illustrated below. Write the correct names in the blanks.

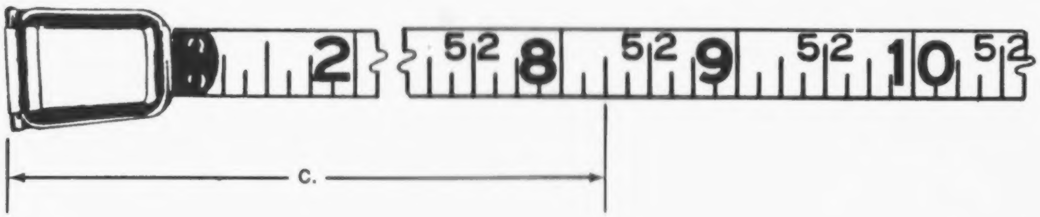

2
12
1
1
1
3
1
13
2
a.
b.
c.
d.
e.
f.

TEST

10. Read the tapes illustrated below to the nearest fraction of an inch. Write the dimensions on the arrows between the reference lines.


2
20
1
20
2
20
3
a.


2
4F
4
4F
5
4F
6
b.


2
52
8
52
9
52
10
52
c.

11. Describe measuring methods used to square lines.

a. 3-4-5 method — ____________________

____

____

____

TEST

b. Diagonal method — ____

____

____

____

(NOTE: Test items 12 and 13 list the assignment and job sheets that are considered an important part of this test. If they have not been completed, check with your instructor.)

12. Measure objects.

13. Demonstrate the ability to use basic measuring tools and the 3-4-5 method to lay out the perimeter of a building on a concrete slab.

MEASURING
UNIT III

ANSWERS TO TEST

1. a. 2
   b. 1
   c. 1
   d. 2
   e. 1
   f. 3
   g. 2
   h. 2
   i. 1
   j. 3
   k. 1
   l. 2
   m. 3

2. a. One-hundred-foot steel tape
   b. Engineer's folding rule
   c. Folding rule
   d. Combination square
   e. Sixteen-foot steel tape
   f. Spring-balanced tape-tension handle
   g. Two-hundred-foot steel tape and reel
   h. Triangular rafter square
   i. Steel framing square

3. Answer should include any five of the following.

   a. Leaving slack in tape
   b. Not laying tape flat (tape is twisted or kinked)
   c. Not aligning tape or rule properly
   d. Not placing end of tape or rule on reference point
   e. Reading incorrect number
   f. Recording incorrect number
   g. Using wrong reference point
   h. Making errors in mathematical computations
   i. Using incorrect measuring tool for job being performed

4. a. Thirty-seconds
   b. Sixteenths
   c. Eighths
   d. Quarters or fourths
   e. Halves
   f. Inches

5. a. 11/16"
   b. 2 1/16"
   c. 2 7/8"
   d. 4 1/4"
   e. 5 1/2"
   f. 6 3/4"
   g. 7 5/8"
   h. 8 7/16"
   i. 9 1/2"
   j. 10 3/4"
   k. 12" or 1'-0"
   l. 13" or 1'-1"

ANSWERS TO TEST

6. a. 0.01′
   b. 0.15′
   c. 0.55′
   d. 0.08′
   e. 0.20′
   f. 0.96′

7. a. Hundredths
   b. Five-hundredths
   c. Tenths
   d. Foot numbers
   e. Tenth number

8. a. 0.88′
   b. 0.29′
   c. 1.00′ or 1′

9. a. Eighth inch
   b. Half inch
   c. Quarter inch
   d. Inch
   e. Inch number
   f. Foot numbers

10. a. 20′ – $1\frac{3}{8}$″
    b. 4′ – 6″ or $4\frac{1}{2}$′
    c. 52′ – $8\frac{1}{4}$″

11. Description should include the following

    a. 3-4-5 method — Forming a right triangle using largest multiple of 3-4-5 feet (6-8-10, 12-16-20, 24-32-40, etc.) possible for length of lines being squared, and ensuring that longest side of triangle is exact appropriate multiple of 5

    b. Diagonal method — Measuring diagonally from inside corners of layout and ensuring that diagonal lines are equal in length

12. Evaluated to the satisfaction of the instructor

13. Performance skills evaluated to the satisfaction of the instructor

BASIC PLAN READING
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to read plans and to read and use an architect's scale. The student will show this knowledge by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with plan reading to their correct definitions.
2. Match to their correct descriptions types of drawings usually included in a set of plans.
3. List information found on types of drawings in a set of plans.
4. Match lines in the alphabet of lines to their correct uses.
5. Identify lines in the alphabet of lines.
6. Identify selected architectural symbols commonly used to represent materials on plans.
7. Identify selected electrical symbols commonly used on plans.
8. Identify selected heating, ventilating, and air-conditioning (HVAC) symbols commonly used on plans.
9. Identify selected plumbing symbols commonly used on plans.
10. Identify selected abbreviations commonly used on plans.
11. Match architect's conventions to their correct representations.
12. State the purposes of written specifications.
13. List basic information included in a set of written specifications.
14. Read an architect's scale.
15. Read plans.
16. Read written specifications.

BASIC PLAN READING
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplements

      1. Supplement #1 — Architectural Terms Commonly Found on Plans

      2. Supplement #2 — Instructions for Concentration Game

   D. Information sheet

   E. Assignment sheets

      1. Assignment Sheet #1 — Read Plans

      2. Assignment Sheet #2 — Read Written Specifications

      3. Assignment Sheet #3 — Read an Architect's Scale

   F. Answers to assignment sheets

   G. Test

   H. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials to supplement unit.

      1. Sets of plans and written specifications for various structures

      2. Examples of perspective, mechanical, and structural drawings

SUGGESTED ACTIVITIES

3. Pictures of different types of period construction

   EXAMPLES: Early American, Old English, Cape Cod, French

4. Competency profiles

   (NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or from The Associated General Contractors of America, 1957 E Street N.W., Washington, D.C. 20006; phone 202-393-2040.)

5. Architect's scales for each member of the class

6. Copy of latest edition of *Architectural Graphic Standards* by Ramsey and Sleeper

C. Make additional copies of assignment sheets and supplements if needed.

D. Introduce unit.

- Compare plan reading with planning a vacation or trip to another city, using a road map.
- Ask questions about what is necessary to build a home or commercial building. Point out that plans provide detailed drawings and that plans and specifications contain all information necessary to complete a job successfully.
- Invite an architect to the class to discuss architect's drawings and plans.

E. Provide students with objective sheet; discuss unit and specific objectives.

F. Provide students with information and assignment sheets.

G. Discuss information and assignment sheets.

(NOTE: For your program, select the specific objectives that reflect your students' chosen occupational areas.)

1. Use Information Sheet, Section I, to discuss terms associated with plan reading.

   - Provide students with copies of Supplement #1, "Architectural Terms Commonly Found on Plans."

SUGGESTED ACTIVITIES

- When discussing nominal and actual dimensions, have students measure a concrete block, 2×4, or other piece of lumber to illustrate the difference between nominal and actual dimensions.

- Show students examples of perspective, mechanical, and structural drawings when discussing these terms.

2. Use Information Sheet, Sections II and III, to discuss the types of drawings usually included in a set of plans.

    - Have students briefly review each drawing in the set of plans in Assignment Sheet #1 so that they can recognize each type of construction plan.

      (NOTE: Students will refer to each plan in this set when studying other sections of the information sheet and when completing the assignment sheets.)

    - Show students examples of perspective, mechanical, and structural drawings.

3. Use Information Sheet, Sections IV and V, to discuss and illustrate the alphabet of lines.

    - Select a drawing from the plans in Assignment Sheet #1 at the end of the Information Sheet, or use one obtained to supplement the unit, and have students identify the different lines on the plan.

4. Use Information Sheet, Sections VI through VIII, to discuss and illustrate symbols commonly used on plans.

    - Select a drawing from the set of plans in Assignment Sheet #1, or use one obtained to supplement the unit, and have students identify symbols found on the plan.

    - Use Supplement #2, "Instructions for Concentration Game," to develop a concentration game for review of symbols.

5. Use Information Sheet, Section VII, to discuss and illustrate electrical symbols commonly used on plans.

    - Select electrical drawing from the set of plans in Assignment Sheet #1, and have students identify symbols found on the plan.

    - Use Supplement #2, "Instructions for Concentration Game," to develop a concentration game for review of electrical symbols.

    - Take students through your building and have them point out electrical items, and then show which symbols should represent the different terms.

SUGGESTED ACTIVITIES

6. Use Information Sheet, Section VIII, to discuss and illustrate heating and air conditioning symbols commonly used on plans.

   - Select HVAC drawing from the set of plans in Assignment Sheet #1 and have students identify symbols found on the plan.

   - Use Supplement #2, "Instructions for Concentration Game," to develop a concentration game for review of heating and air conditioning symbols.

   - Take a tour of a construction job where heating and air conditioning is being installed. Ask students to show you which symbols should be used to represent particular heating and air conditioning items being installed.

7. Use Information Sheet, Section IX, to discuss and illustrate plumbing symbols commonly used on plans.

   - Select plumbing drawing from the set of plans in Assignment Sheet #1 and have students identify symbols found on the plans.

   - Use Supplement #2, "Instructions for Concentration Game," to develop a concentration game for review of plumbing symbols.

   - Take a tour of a construction job where plumbing is being installed; ask students to show you which symbols should be used to represent particular plumbing items being installed.

8. Use Information Sheet, Section X, to discuss abbreviations commonly used on plans.

   - Develop a set of flash cards containing the various abbreviations. Have students use the cards in teams, or show the class the cards and have individuals give you the correct answers.

   - Select a drawing from the set of plans in Assignment Sheet #1, or use one obtained to supplement the unit, and have students identify the abbreviations on it.

   - Have students complete Assignment Sheet #1, "Read Plans." Point out that the plans have been reduced and that the scales are no longer accurate. After students have completed the assignment sheet, discuss the answers in class.

9. Use Information Sheet, Section XI, to discuss conventions used by architects.

   - Invite an architect to the class to discuss and demonstrate the conventions used in architect's drawings.

   - Select a drawing from the set of drawings in Assignment Sheet #1, or use one obtained to supplement the unit, to illustrate conventions.

SUGGESTED ACTIVITIES

10. Use Information Sheet, Sections XII and XIII, to discuss written specifications.
    - Point out that the description of materials in Assignment Sheet #2, "Specifications," is only part of a set of specifications for a particular residential building.
    - Prepare a bulletin board showing the relationships between plans and written specifications.
    - Have students complete Assignment Sheet #2, "Read Written Specifications." Critique and discuss it in class.
    - Provide students with specifications for a building in your community. Discuss them.
    - Invite a contractor to the class to explain how bids are made based on plans and written specifications for a building.
11. Use Information Sheet, Section XIV, and Assignment Sheet #3, "Read an Architect's Scale," to discuss reading the architect's scale.
    - Provide each student with an architect's scale.
    - Have students complete Assignment Sheet #3 so that they may practice reading the different scales on an architect's scale.
    - Have students use *Architectural Graphic Standards* to learn the different dimensioning systems.
12. Visit construction sites that are in different phases of construction. Obtain construction plans so that students can read the plans to determine the next steps to be taken.

H. Give test.

I. Critique test and discuss in class.

J. Reteach if necessary.

K. Complete appropriate section of competency profiles.

III. Unit reference

Hendrix, Laborn J. "Bud." *Fundamentals of Concrete and Cement Masonry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1987.

BASIC PLAN READING
UNIT IV

SUPPLEMENT #1 — ARCHITECTURAL TERMS COMMONLY FOUND ON PLANS

Acoustics — Science of sound; in construction, acoustical materials used to keep down noise within a room or to prevent noise from passing through walls

Air conditioner — Apparatus that can cool, clean, and circulate air

Air duct — Pipe that conducts air to rooms from a central source

Anchor bolt — Threaded rod inserted in masonry construction for anchoring the sill plate to the foundation

(NOTE: Anchor bolts may also be called *hold-down bolts, foundation bolts,* or *sill bolts.)*

Apron — Finish board immediately below a window sill; also the part of the driveway that leads directly into the garage and the part that leads directly to the street

Ashpit — Area that collects ashes below the hearth of a fireplace

Asphalt shingles — Composition roof shingles made from asphalt-impregnated felt covered with mineral granules

Attic — Space between the roof and the ceiling; also called *garret*

Backfill — Earth used to fill in areas around exterior foundation walls

Baffle — A partial block against a flow of wind or sound

Batt — Blanket insulation material

Beam — Horizontal structural member that carries a load

Bearing wall — A wall supporting any vertical load other than its own weight

BTU — Abbreviation for *British thermal unit*, a standard unit for measuring heat gain or loss

Built-up roof (BUR) — Roofing material composed of several layers of felt and asphalt

Camber — Concave or convex curvature of a surface

Cantilever — Projecting member supported only at one end

Catch basin — Underground water-drainage structure connected with a sewer or drain

Caulking — Waterproof material used to seal cracks

Central heating — Single source of heat distributed by pipe or ducts

SUPPLEMENT #1

Chase — Vertical space within a building for ducts, pipes, and wires

Check valve — Valve that permits passage through a pipe in only one direction

Circuit — Path of an electric current; the closed loop of wire in which an electric current can flow

Circuit breaker — Device used to open and close an electrical circuit

Conductor — A drain pipe leading from the roof; anything that permits the passage of an electric current

Convector — Heat transfer surface that uses convention currents to transfer heat

Cull — Building material rejected as below standard grade

Damper — Movable plate that regulates the draft of a stove, fireplace, or furnace

Dehumidify — Reduce the moisture content in the air

Downspout — Pipe used to carry rainwater from the roof

Drywall construction — Interior wall covering other than plaster; also called *gypsum board*

Easement — Right to use land owned by another, such as a utility company's right-of-way

Elbow — An L-shaped pipe fitting

Excavation — Cavity or pit produced by digging the earth in preparation for construction

Facade — Face or front elevation of a building

Fenestration — Arrangement of windows

Filled insulation — Loose insulation material poured from bags or blown by machines

Firedoor — Door that will resist fire

Floorplug — Electrical outlet flush with the floor

Frostline — Depth of frost penetration into the soil

Fuse — Strip of soft metal inserted in a circuit, designed to melt and open the circuit should the current exceed predetermined value

Gussett — Plywood or metal plate used to strengthen joints

Heat pump — Heating and cooling unit; in winter it pumps heat from outside into the building; in summer it pumps heat from the building to outside

SUPPLEMENT #1

Hose bib — Combination shut-off valve and threaded faucet allowing a hose to be attached

House drain — Horizontal sewer pipe within a building that receives waste from the soil stacks

Keystone — The top, wedge-shaped stone of an arch

Knob and tube — Electric wiring through walls where insulated wires are supported with porcelain knobs and tubes when passing through wood construction members

Lolly column — Steel column used as a support for girders and beams

Leaching bed — System of trenches that carries waste from sewer

Loggia — Roofed, open passage along the front or side of a building, usually at an upper level

Modular construction — Construction in which the size of the building and the building materials are based on a common unit of measure

Monolithic — Continuous mass of concrete cast as a single unit

Mosaic — Small, colored tile, glass, stone, or similar material arranged on an adhesive ground to produce a decorative surface

Outlet — Type of electrical box allowing current to be drawn from the electrical system for lighting or appliances

Panelboard — Center for controlling electrical circuits

Pinnacle — Projecting or ornamental cap on the high point of a roof

Plenum system — System of heating or air conditioning in which the air is forced through a chamber connected to distributing ducts

Portico — A roof supported by columns

Quad — An enclosed court

Quoins — Large squared stones set in the corners of masonry buildings for appearance

Radiant heating — System using heat elements in the floor, ceilings, or walls to radiate heat into the room

Raglet — Open joint in masonry to receive flashing

Rheostat — Instrument for regulating electric current

Riser — Vertical portion of a step

SUPPLEMENT #1

Rockwool — Insulating material that looks like wool but is composed of substances as granite or silica

Run — Horizontal distance covered by a flight of stairs; width of a step; length of a rafter

Service connection — Electric wires from outside power lines to the building

Sill — Horizontal exterior member of a window or door opening; wood member placed directly on top of the foundation wall in wood frame construction

Solar heat — Heat from the sun's rays

Steening — Brickwork without mortar

Swale — Drainage channel formed where two slopes meet

Thermal conductor — Substance capable of transmitting heat

Thermostat — Device for automatically controlling the supply of heat

Transom — Small window over a door

Valve — Device that regulates the flow of material in a pipe

Vapor barrier — Watertight material used to prevent the passage of moisture or vapor into and through walls and floors

Ventilation — Process of supplying and removing air by natural or mechanical means to or from any space

Vent pipes — Small ventilating pipes extending from each fixture of a plumbing system to the vent stack

Vent stack — Upper portion of a soil or waste above the highest fixture

Vitreous — Resembling glass

Well opening — Floor opening for a stairway

BASIC PLAN READING
UNIT IV

SUPPLEMENT #2 — INSTRUCTIONS FOR CONCENTRATION GAME

PURPOSE

Concentration provides the opportunity to eliminate the boredom of repetition in drilling students to learn the basics. It is an enjoyable classroom activity that allows students to match closely related terms and information.

(NOTE: Concentration is a classroom alternative that can be improvised with a very minimal investment of dollars and cents. The basic board can be personalized to address many group and individual learning needs in nearly every subject area.)

PREPARATION

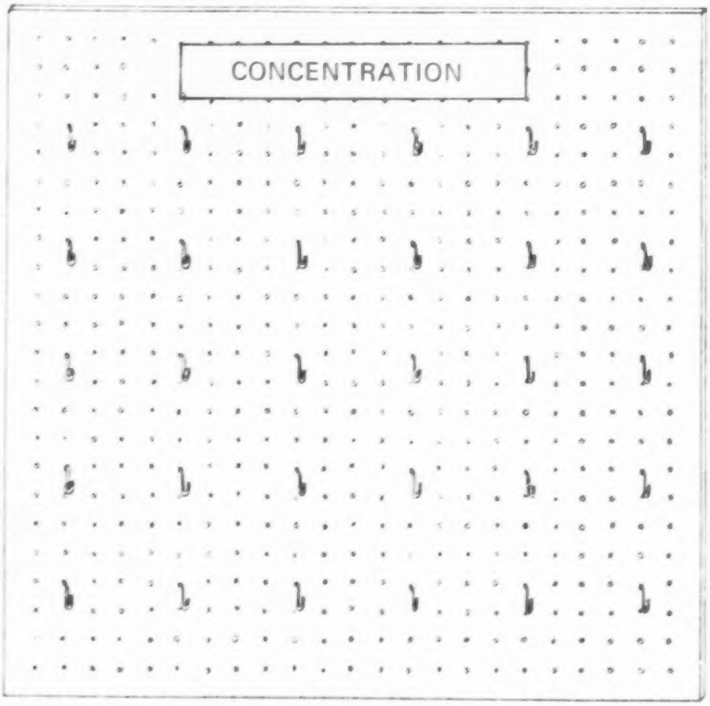
A. Gather the following materials to construct a basic Concentration board

Pegboard, 24 inches by 30 inches
Pegboard hooks, approximately 30 to 36
Poster board or index cards, all one color
Spray paint, optional
Scissors
Glue
Hole punch

B. Paint the pegboard if desired, and allow to dry

C. Write the word CONCENTRATION on a piece of poster board and glue to the top of the pegboard

D. Position the pegboard hooks



SUPPLEMENT #2

E. Cut 3-by-5-inch cards from colorful poster board (cards should all be the same color), or use unlined index cards

F. Number one side of each card from 1 to 36, or adapt to twice the actual number of terms, items, and so on that the student will identify

G. Shuffle the numbered cards to mix the numbers, and then write terms, or paste or draw shapes, objects, or pictures on the unnumbered sides of the cards

(NOTE: If you want students to match terms to their definitions, write the terms and definitions on the cards, pairing each with a symbol such as a star, circle, etc. Another option is to add two or four wild cards that will match any combination. Be sure to pair every word, shape, object, or picture. Once the cards are made, they can double as flash cards or playing cards to involve students in pairs.)

H. Punch a hole in the top of each card, and place the cards on the hooks in numerical sequence, with the numbered side showing

PLAY

A. The beginning student or team selects two numbers

EXAMPLE: 2 and 27

B. If the words, shapes, objects, or pictures match, the student or team earns a point, or has the opportunity to give a definition, or identify the object or picture to earn a point

C. If the cards match and the point is earned, the cards that match should remain turned out, with their numbers now facing the board

D. If the cards do not match, they are returned to their original playing position with numbers facing out, and the turn goes to the opposition

E. The game continues until the backs of all cards are revealed and matched

F. The student or team that provides the highest number of matches (points) wins the game

(NOTE: The instructor may want to present a reward or a token of accomplishment to the winning student or team.)

BASIC PLAN READING
UNIT IV

INFORMATION SHEET

I. Terms and definitions associated with plan reading

A. **Architect's drawings** — Set of detailed working drawings or plans drawn to scale by an architect, showing all information and dimensions necessary to build or remodel a structure; original drawings from which blueprints are made

(NOTE: The working drawings or architect's plans consist of several different kinds of drawings, usually assembled into a set: plot plan, foundation plan, floor plan[s], elevation drawings, section drawing[s], detail drawings, electrical drawings, HVAC drawings, and plumbing drawings. The set will also include finish schedules and may include a perspective drawing and a structural drawing.)

B. **Blueprints** — Reproductions of architect's drawings; also called *plans* or *construction plans*

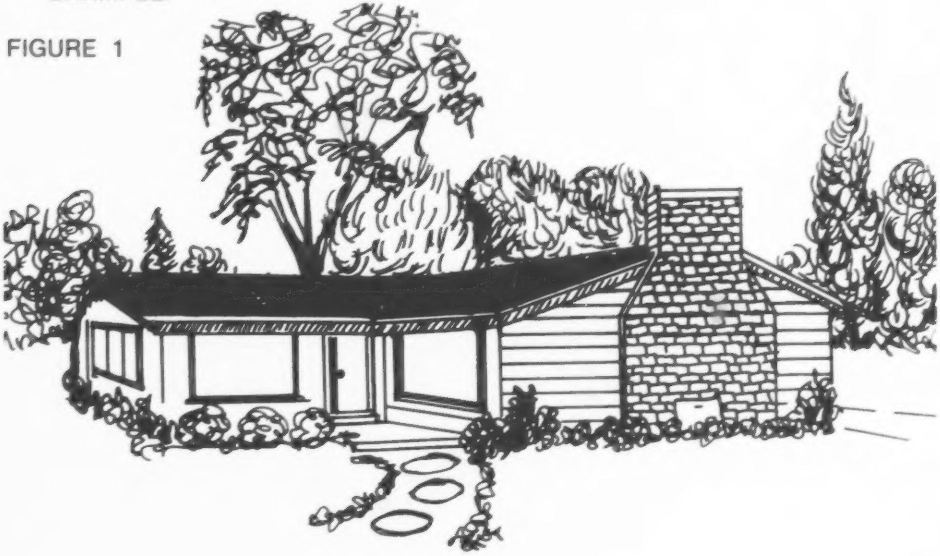
(NOTE: A true blueprint has white lines on a blue background; however, most of today's reproductions produce a black-, blue-, or sepia-colored line on a white background. See Assignment Sheet #1 at the end of the Information Sheet.)

C. **Perspective drawing** — Drawing having many of the features of a photograph; drawn by the architect to interest buyers (Figure 1)

(NOTE: Whenever perspective drawings are available, the construction worker should use them to help visualize the many details that appear on construction plans.)

EXAMPLE:

FIGURE 1



INFORMATION SHEET

D. **Structural drawing** — Drawing by a structural engineer; may accompany architect's plans and give important information about the foundation, skeleton, and floor systems

(NOTE: Structural plans are usually drawn for large structures such as an office building or factory. They include such details as heights of finished floors and walls; height and bearing of bar joist or steel joist; locations of bearing steel material; height of steel beams, concrete plank, concrete Ts, and poured-in-place concrete; bearing plate locations; location, size, and spacing of anchor bolts; and stairways.)

E. **Mechanical drawing** — Drawing showing location and details about plumbing and electrical components and heating and air-conditioning units

(NOTE: Mechanical features may be drawn on the basic floor or foundation plan or may be shown in separate drawings.)

F. **Specifications** — Detailed set of written instructions that supplements the set of plans, describes equipment and materials used in the structure, and becomes part of the contract (See Assignment Sheet #2 at end of information sheet.)

G. **Finish schedule** — Listing or chart of parts (keyed to the plans), amounts, materials or products, and details (Figures 2 and 3)

(NOTE: Schedules may appear on the same page as a plan or on a separate page in the set of plans. Schedules may be listed for windows, doors, room finishes, floor types and finishes, paint, appliances, fixtures, lintels, headers, and reinforcing steel. See Sheet #14 in Assignment Sheet #1.)

EXAMPLES:

FIGURE 2

DOOR SCHEDULE FOR ENTIRE HOUSE

MARK	SIZE	AMT REQ'D	REMARKS
A	5'-0" x 6'-8" x 1¾"	1	EXTERIOR FLUSH DOOR
B	2'-8" x 6'-8" x 1¾"	7	FLUSH DOORS 1 SLIDING 1 METAL CLAD
C	2'-6" x 6'-8" x 1⅜"	4	FLUSH DOOR
C_1	2'-6" x 6'-8" x 1⅜"	2	LOUVERED
D	2'-4" x 6'-8" x 1⅜"	4	FLUSH DOOR
D_1	2'-4" x 6'-8" x 1⅜"	1	LOUVERED
E	1'-3" x 6'-8" x 1⅜"	1	BIFOLD LOUVERED
F	2'-10" x 6'-8" x 1¾"	2	EXTERIOR 2 LIGHTS
G	2'-8" x 6'-8" x 1¾"	1	EXTERIOR 2 LIGHTS

FIGURE 3

WINDOW SCHEDULE

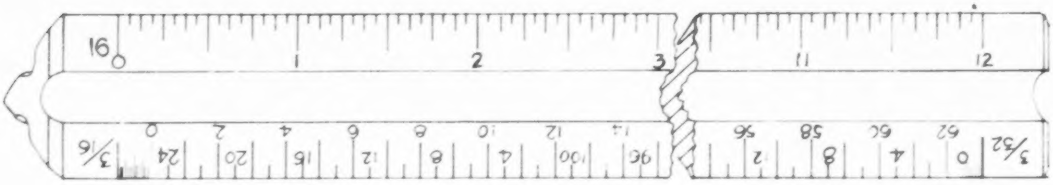
MARK	SIZE	REMARKS
A	(2) 3'-0" x 4'-2"	DH SEE SPECS
B	(2) 3'-0" x 3'-2"	–
C	—	TRIMLINE BAY 53R
D	2'-7" x 4'-2"	DH SEE SPECS
E	1'-6" x 3'-2"	–
F	2'-6" x 2'-9"	231B CASEMENT
G	3'-0" x 3'-2"	DH SEE SPECS
H	2'-0" x 5'-5"	FIXED SEE SPECS

INFORMATION SHEET

H. **Architect's scale** — Three-sided rule with six ruled faces designed to measure in twelve different scales of proportional feet and inches (Figure 4)

EXAMPLE:

FIGURE 4



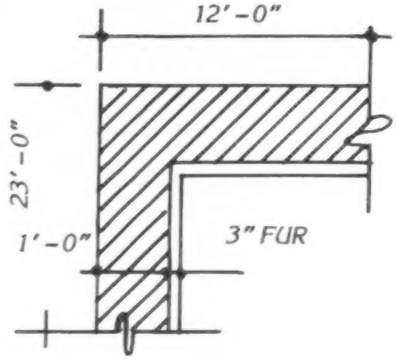
I. **Scale drawing** — Drawing made to a size either proportionally larger or smaller than the actual size of the object represented

(NOTE: The scale to which the architect makes a drawing is always indicated on the drawing, generally below the title. Detail and section drawings may be drawn on a larger scale than the other drawings in the set of plans.)

J. **Convention** — Architect's standard methods of representing dimensions and structural details (Figure 5)

EXAMPLE: Exterior solid brick wall

FIGURE 5



K. **Visualization** — Important aspect of plan reading that involves looking at and thinking about a structural detail, or a symbol for such a detail, and being able to form a mental picture of how such a detail is constructed or assembled

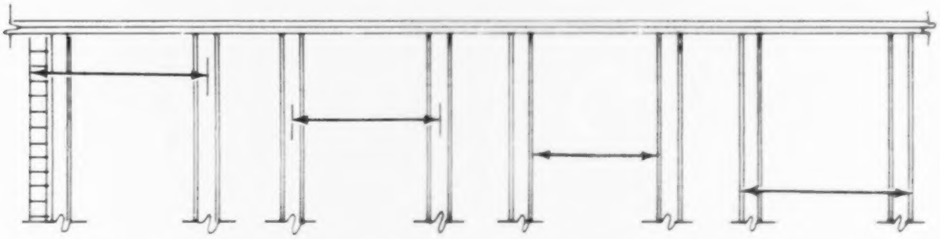
INFORMATION SHEET

L. **Dimensioning** — Using conventional dimension lines and figures to indicate actual sizes and distances of objects and spaces represented

(NOTE: Dimensioning may be from outside to center, center to center, wall to wall, or outside to outside. See Figure 6. In all cases, dimensions are given in full scale regardless of the fact that the plan shows an object or distance on a smaller scale. Section and detail views may use nominal sizes in labeling.)

EXAMPLE:

FIGURE 6



M. **Nominal dimension** — Approximate or rough size of a unit

EXAMPLES: 2×4 board, 8″ × 8″ × 16″ concrete block

N. **Actual dimension** — Exact measured size of a unit

EXAMPLES: A 2×4 board is actually 3½ by 1½ inches; an 8″ × 8″ × 16″ concrete block is actually 7⅝″ × 7⅝″ × 15⅝″.

O. **Elevation** — 1) Given grade; 2) outside view of a structure

(NOTE: The word *elevation* has two quite different meanings in construction. See Figure 7 for elevations of particular points on a drawing. See Sheets 4 and 5 of the Assignment Sheet #1 for illustrations of the second meaning of *elevation*.)

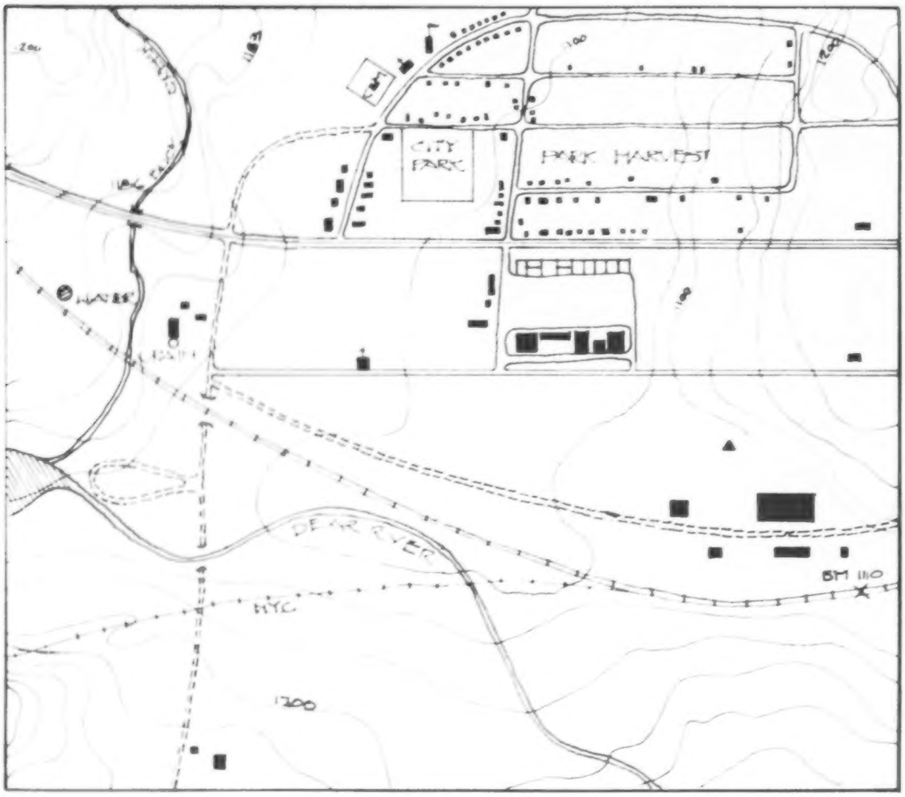
P. **Benchmark** — Point of known or assumed elevation used by surveyor as a reference point in determining other elevations (See Figure 7)

INFORMATION SHEET

Q. **Topographical survey** — Drawing of natural and man-made features of a place or region showing their relative positions and elevations (Figure 7)

EXAMPLE:

FIGURE 7



R. **Contour lines** — Lines used on plot plans and topographical surveys to show both natural grade and finish grade elevations (See Figure 7)

II. Descriptions of types of drawings usually included in a set of plans

A. **Plot plan** — Horizontal view showing where the building is to be located on the site (See Sheet #1 in Assignment Sheet #1)

B. **Foundation plan** — Horizontal view of entire masonry substructure below first floor or frame of building (See Sheet #2 in Assignment Sheet #1)

C. **Floor plan** — Horizontal view of building, showing length and breadth of building and layout of rooms on that floor (See Sheet #3 in Assignment Sheet #1)

INFORMATION SHEET

D. **Elevation** — Vertical, two-dimensional view of each of the exterior faces of a building, showing general shape and design of exterior and roof (See Sheets #4 and #5 in Assignment Sheet #1)

E. **Section** — Cut-away vertical view through an object or wall to show its interior makeup (See Sheet #6 in Assignment Sheet #1)

(NOTE: A section view is limited to the specific portion of the building the architect wishes to clarify, and may be drawn on the same sheet as an elevation or plan or may appear on a separate sheet.)

F. **Detail** — Graphic, at a larger scale, of part of another drawing, indicating special features of design, location, and composition and the correlation of the elements and materials shown (See Sheets #7 through #10 in Assignment Sheet #1)

(NOTE: Detail drawings often use the cut-away section view to show aspects that are too small to be shown in sufficient detail on plan or elevation drawings. Like section drawings, detail drawings may be drawn on the same sheet as an elevation or plan drawing or may appear on a separate sheet in the set of plans.)

G. **Electrical floor plan** — Floor plan with electrical symbols showing exact locations of switches, outlets, and electrical devices to accommodate appliances and fixtures; also lines that represent wiring from each switch to the connecting fixture (See Sheet #11 in Assignment Sheet #1)

H. **Heating, ventilating, and air conditioning (HVAC) floor plan** — Floor plan with heating, ventilating and air conditioning symbols showing location and types of equipment, movement of hot and cold air, and location and size of ducts and diffusers (See Sheet #12 in Assignment Sheet #1)

I. **Plumbing floor plan** — Floor plan with symbols representing location and type of fixtures, vents, valves and pipe that will be installed in the structure (See Sheet #13 in Assignment Sheet #1)

III. Information found on types of drawings in a set of plans

A. Plot plan

1. Location, dimensions, and elevation of structure on site
2. Finished and existing grade contours
3. Property lines and dimensions
4. Location of utilities
5. Location of existing conditions

   EXAMPLES: Trees, utility buildings, other structures

6. Location and dimensions of driveways and walks

B. Foundation plan

1. Location and dimensions of footings, grade beams, foundation walls, stem walls, piers, equipment footings, foundations
2. Location of anchor bolts (in detail view)

INFORMATION SHEET

C. Floor plan

1. Outside walls, including location and dimensions of all exterior openings
2. Types of construction materials
3. Location of interior walls and partitions
4. Location and swing of doors
5. Stairways
6. Location of windows
7. Location of cabinets, electrical and mechanical equipment, fixtures
8. Location of cutting plane line

D. Elevation

1. Grade lines
2. Floor height
3. Window and door types
4. Roof lines and slope, roofing material, vents, gravel stops, projection of eaves
5. Exterior finish materials and trim
6. Exterior dimensions

E. Section

1. Details of construction and information about stairs, walls, chimneys, or other parts of construction that may not show clearly on plan
2. Floor levels in relation to grade
3. Wall thickness at various locations
4. Anchors and reinforcing steel

F. Detail

(NOTE: The following list itemizes types of information that may require a detail drawing. All of the items listed would never appear on a single detail drawing.)

1. Footings and foundations, including anchor bolts, reinforcing, control joints
2. Beams, floor joists, bridging, other support members
3. Sills, floor framing, exterior walls, vapor barriers
4. Floor heights, thickness, expansion, reinforcing

INFORMATION SHEET

5. Interior walls

6. Windows, exterior and interior doors, door frames

7. Roof, cornice, soffit, ceilings

8. Gravel stops, fascia, flashing

9. Fireplaces, chimneys

10. Staircases, stair assembly

11. Millwork, trim, ornamental iron, specialty items

IV. Uses of lines in the alphabet of lines

A. **Object line** — Used to show main outline of structure, including exterior walls, interior partitions, porches, patios, sidewalks, parking lots, and driveways

(NOTE: Object lines are always the heaviest lines in the drawing.)

B. **Dimension line** — Used to designate object and area dimensions

(NOTE: Dimension lines may end in arrows, dots, or slashes. The dimension is usually written above the dimension line.)

C. **Extension lines** — Used as parameters for dimension lines

D. **Hidden line** — Used to show lines that are not visible from view depicted

E. **Center line** — Used to designate center and to provide a reference point for dimensioning

F. **Cutting plane (section line)** — Used to indicate an area that has been cut away and shown in a section view; arrows indicate direction from which section drawing is to be viewed

G. **Phantom line** — Used to indicate alternative positions of moving parts, adjacent positions of related parts, and for repeated details

H. **Break line** — Used to show that an object or area has not been drawn in its entirety

I. **Leader line** — Used to connect a note or dimension to a related part of the drawing

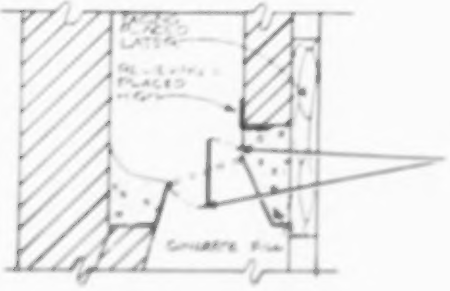
(NOTE: Leader lines are sometimes curved to avoid confusion with dimension lines and other lines.)

INFORMATION SHEET

V. Lines in the alphabet of lines (Figures 8 and 9)

A. Phantom line

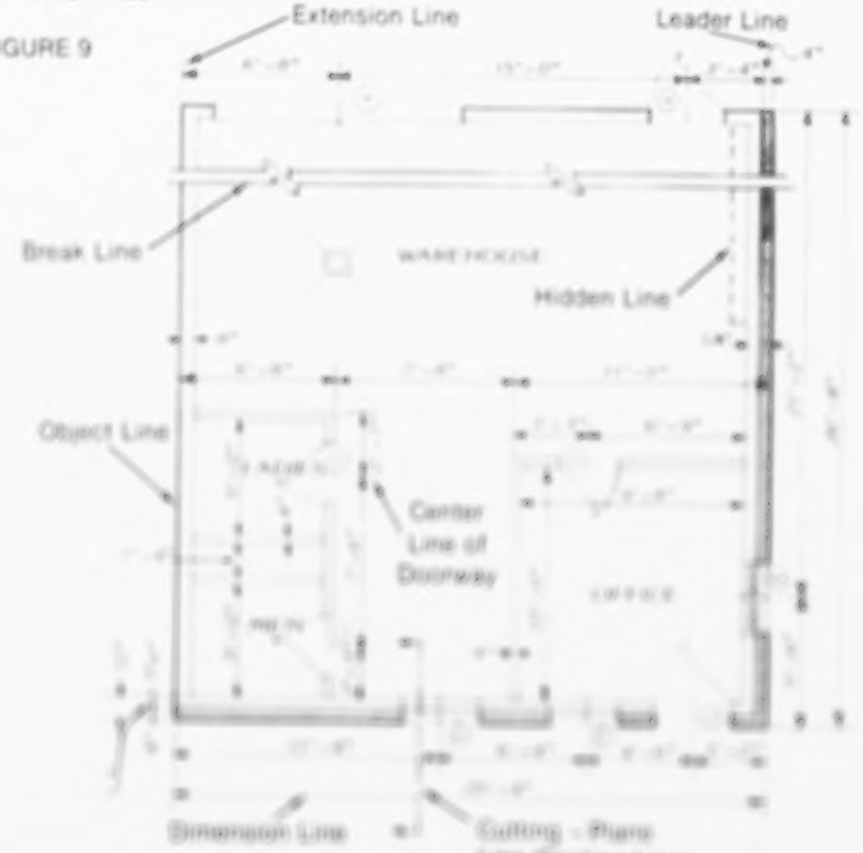
FIGURE 8


Phantom Lines Showing Damper Swing
Concrete Fill

Used with permission of John Wiley and Sons, Inc., New York, from *Architectural Graphic Standards*, 6th edition, by Charles G. Ramsey and Harold R. Sleeper, edited by Joseph N. Boaz, 1970.

B. Other lines

FIGURE 9

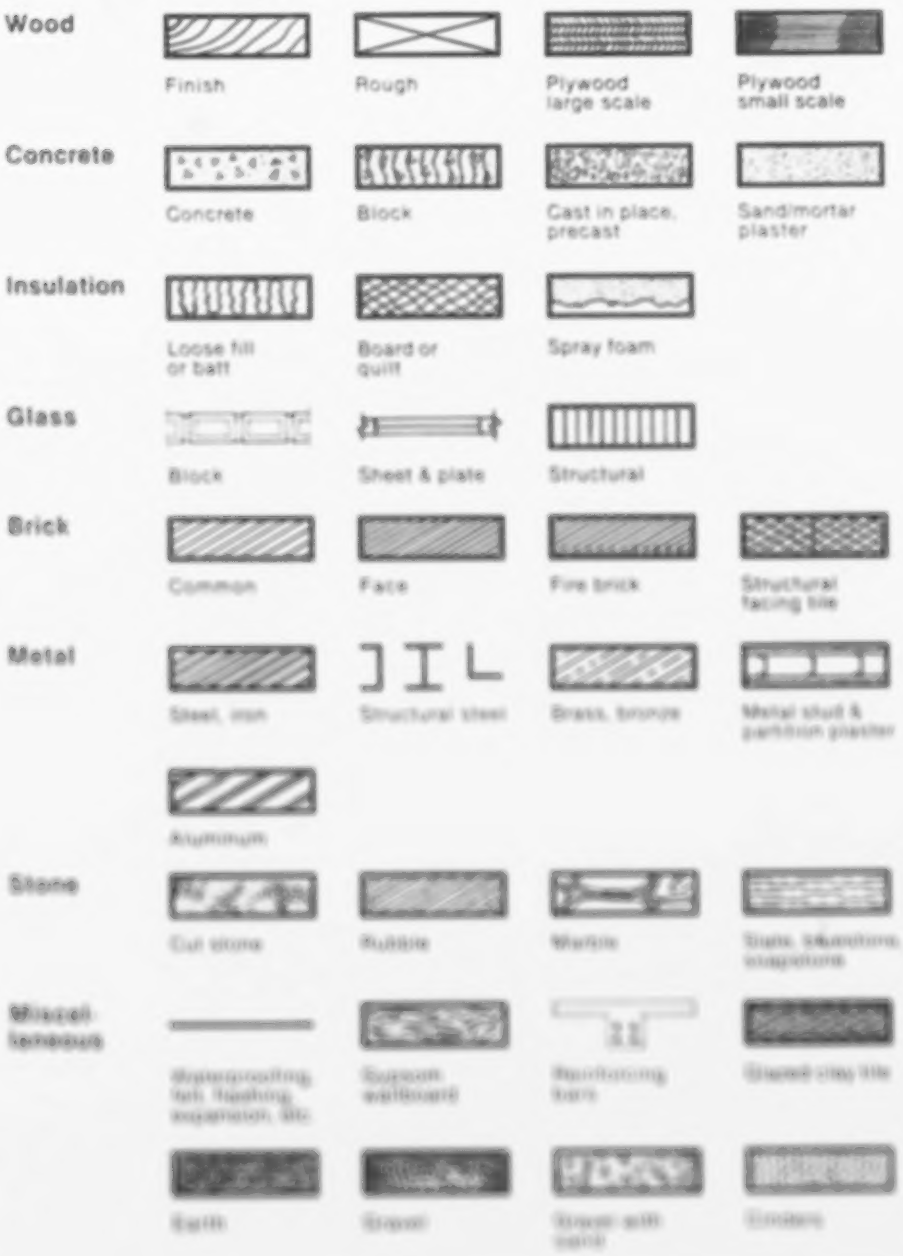

Extension Line
Leader Line
Break Line
WAREHOUSE
Hidden Line
Object Line
Center Line of Doorway
OFFICE
Dimension Line
Cutting - Plane Line (Section Line)

INFORMATION SHEET

VI. Materials symbols commonly used on plans

A. General plan symbols (Table 1)

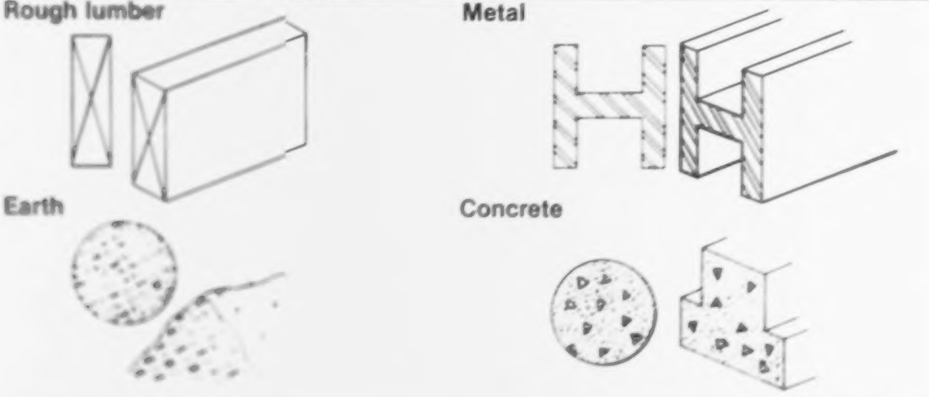
TABLE 1 General plan symbols


Wood
Finish
Rough
Plywood large scale
Plywood small scale
Concrete
Concrete
Block
Cast in place, precast
Sand/mortar plaster
Insulation
Loose fill or batt
Board or quilt
Spray foam
Glass
Block
Sheet & plate
Structural
Brick
Common
Face
Fire brick
Structural facing tile
Metal
Steel, iron
Structural steel
Brass, bronze
Metal stud & partition plaster
Aluminum
Stone
Cut stone
Rubble
Marble
Slate, bluestone, soapstone
Miscellaneous
Waterproofing, felt, flashing, expansion, etc.
Gypsum wallboard
Reinforcing bars
Glazed clay tile
Earth
Gravel
Gravel with sand
Cinders

INFORMATION SHEET

B. Section view symbols (Table 2)

TABLE 2 Section view symbols



VII. Electrical symbols commonly used on plans (Table 3)

TABLE 3 Common electrical symbols

Lighting outlets		Receptacle outlets	
Junction box, ceiling	Ⓙ	Single receptacle outlet	–⊖
Exit light outlet, wall	–Ⓧ	Duplex receptacle outlet	=⊖
Fan outlet, ceiling	Ⓕ	Grounded outlet, duplex	=⊖$_{GR}$
Recess incandescent, wall	–Ⓡ	Special-purpose receptacle outlet, single	–◁
Surface incandescent, ceiling	○	Weatherproof outlet, duplex	=⊖$_{WP}$
Surface incandescent, wall	–○	Switch and single receptacle	–⊖$_{S}$
Lamp holder with pullswitch	Ⓛ$_{PS}$	Range outlet	≡⊖$_{R}$
Surface or pendant site fluorescent fixture	▭	Television outlet	TV
Combination ceiling fan-descent, vent andheater	▨	Special-purpose outlet, clothes dryer	–◀$_{CD}$

(NOTE: Subscript letters with the symbol indicate functions, such as "DW" for dishwasher, "DF" for drinkfountain, or "CD" for clothes dryer)

INFORMATION SHEET

TABLE 3 — (Continued)

Switch outlets		Auxiliary systems	
Single-pole switch	S	Telephone jack	⧏
Double-pole switch	S_2	Buzzer	▭/
Three-way switch	S_3	Bell	o▭
Four-way switch	S_4	Electric door opener	$\boxed{D}$
Switch and pilot lamp	S_P	Chime	$\boxed{CH}$
Weatherproof switch	S_{WP}	Push button	⊡
Fused switch	S_F	Bell and buzzer combination	o▭/
Circuit breaker	S_{CB}	Kitchen ventilating fan	⊛
Low-voltage system switch	$\underline{S}$	Vacuum outlet	▽
Automatic-door switch	S_D	Thermostat	Ⓣ

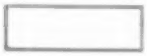
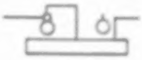
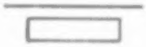
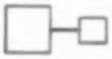
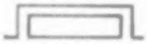
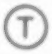
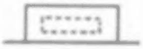
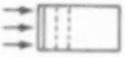
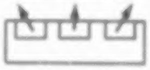
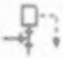
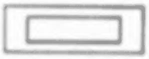
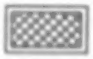
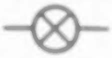
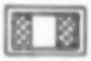
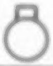
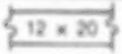
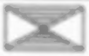
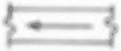
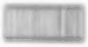
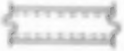
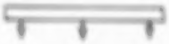
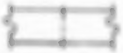
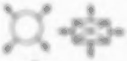
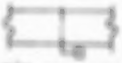
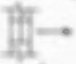
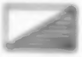
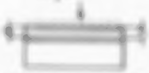
Panels and miscellaneous

Lighting panel (Distribution panel)	■	Wiring, concealed in ceiling or wall	———
Power panel	▨	Wiring, concealed in floor	— — — — —
Transformer	△	Wiring, exposed	············
Electrical distribution pole	○	Home run to panel board	—•—•—
Meter	—Ⓜ— $\boxed{M}$	Feeders	━━━
Service weather	◖—		

INFORMATION SHEET

VIII. HVAC symbols commonly used on plans (Table 4)

TABLE 4 Common HVAC symbols

Heating and Ventilating			
Heat transfer surface		Condenser	
Exposed radiator		Pump	
Recessed radiator		Thermostat	
Enclosed radiator flush		Intake louvers and screen	
Unit heater (centrifugal)		Automatic air vent	
Unit ventilation		Wall or space heater	
Thermostatic trap		Combination ceiling light, vent, and heater	
Compressor		Gas outlet	
Ductwork			
Duct size		Supply duct section	
Direction of flow in duct		Floor register	
Lined ductwork		Linear diffuser	
Manual volume damper		Supply outlet, ceiling diffuser	
Automatic volume damper		Louver opening	
Exhaust, return or outside air duct section		Intake louvers on screen	
Heating Pipes			
Gas line, low pressure	—— G —— G ——	Fuel oil return	—— FOR ——
Gas line, medium pressure	—— MG ——	Hot water heating supply	—— HW ——
Gas line, high pressure	—— HG ——	Hot water heating return	—— HWR ——
Fuel oil supply	—— FOS ——		

INFORMATION SHEET

IX. Plumbing symbols commonly used on plans (Table 5)

TABLE 5 Common plumbing symbols

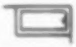
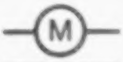
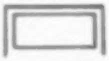
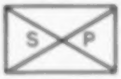
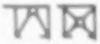
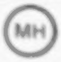
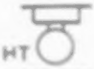
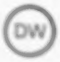
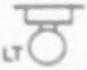
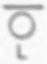
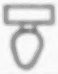
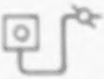
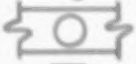
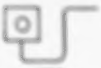
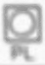
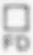
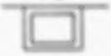
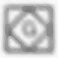
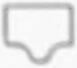
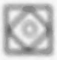
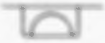
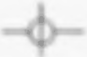
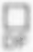
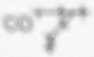
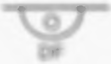
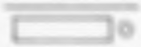
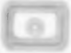
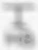
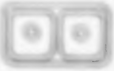
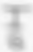
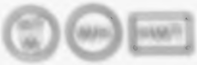
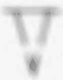
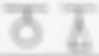
Fixtures		Accessories	
Corner bath		Meter	
Recessed bath		Sump pit	
Shower stall		Manhole drain	
Water closet, high tank		Dry well drain	
Water closet, low tank		Leader drain	
Water closet, standard		Floor drain with back water valve	
Lavatory, built-in		Garage floor drain	
Lavatory, pedestal		Floor drain	
Lavatory, standard		Grease separator	
Urinal, wall type		Oil separator	
Urinal, stall type		Floor cleanout	
Drinking fountain		Pipe cleanout	
Drinking fountain, wall type		Hose rack	
Sink, residential single		Hose bib	
Sink, residential double		Gas outlet	
Hot water heater		Vacuum outlet	
Shower head			

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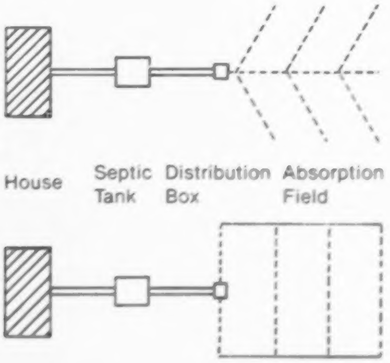
TABLE 5 — (Continued)

Septic Systems



Lines

Soil, waste or leader line, above grade	————————
Soil, waste or leader line, below grade	— — — — — — —
Vent line	- - - - - - - - - - - - - - -
Combination waste and vent line	——— CWV ———
Cold water line	—-—-—-—-—-—-—
Hot water line	—--—--—--—--—
Gas line	——G——G——
Sewer cast-iron line	S-CI ━━━━━━━━
Vacuum line	———V———

X. Abbreviations commonly used on plans (Table 6)

TABLE 6

Access panel	AP	Bedroom	BR
Aggregate	AGGR	Benchmark	⊕ or BM
Alternating current	AC	Blocking	BLKG
Ampere	AMP	Blower	BLO
Anchor bolt	AB	Both sides	BS
Angle, angle iron	∠	Brick	BRK
Architectural	ARCH	Broom closet	BC
Bathroom, block	B	Building	BLDG
Beam	BM	Building line	BL

INFORMATION SHEET

TABLE 6 (Continued)

Cast iron	**CI**	Downspout	**DS**
Cellar	**CEL**	Dryer, duct	**D**
Cement	**CEM**	Electric	**ELEC**
Centerline	℄ or **CL**	Elevation	**EL**
Center to center	**C** to **C**	Excavate	**EXC**
Circuit	**CKT**	Exhaust	**E**
Circuit breaker	**CIRBKR**	Existing	**EXIST**
Clapboards	**CLAPBDS**	Expansion joint	**EXP JT**
Closet	**CL**	Exterior	**EXT**
Cold water	**CW**	Fabricate	**FAB**
Column	**COL**	Finish ceiling	**FIN CEIL**
Combination	**COMB.**	Finish floor	**FIN FL**
Common	**COM**	Finish grade	**FG**
Concrete	**CONC**	Fireproof	**FPRF**
Conduit	**CND**	Flashing, floor	**FL**
Construction	**CONST**	Floor drain	**FD**
Courses	**C**	Fluorescent	**FLUOR**
Deadload	**DL**	Footing	**FTG**
Degree	(°) or **DEG**	Foundation	**FDN**
Detail	**DET**	Furring	**FUR**
Diameter	**DIA**	Galvanized iron	**GI**
Dimension	**DIM**	Garage	**GAR**
Dining room, drain	**DR**	Grade	**GR**
Double hung	**DH**	Grade line, glass	**GL**

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TABLE 6 (Continued)

Hall	**H**	Maximum	**MAX**
Hardware	**HDW**	Meter, masonry	**M**
Heater	**HTR**	Minimum	**MIN**
Height	**HT**	Miscellaneous	**MISC**
Hose bib	**HB**	Modular	**MOD**
Hot water	**HW**	Nominal	**NOM**
I beam	**I**	Not to scale	**NTS**
Insulate, insulation	**INS**	On center	**OC**
Interior	**INT**	Opening	**OPNG**
Joint	**JT**	Ornamental iron	**OI**
Kilowatt	**KW**	Overhead	**OVHD**
Kilowatt hour	**KWH**	Panel	**PNL**
Kitchen	**KIT**	Partition	**PTN**
Laundry	**LAU**	Plaster, plate	**PL**
Lavatory	**LAV**	Precast	**PRCST**
Left, leader, line	**L**	Prefabricated	**PREFAB**
Length overall	**LOA**	Quality	**QUAL**
Linear	**LIN**	Quantity	**QTY**
Linen closet	**LCL**	Receptacle	**RECP**
Live load	**LL**	Reference, refrigerator	**REF**
Living room	**LR**	Reinforce	**REINF**
Louver	**LV**	Required	**REQD**
Lumber	**LBR**	Riser	**R**
Manufacturing	**MFG**	Room	**RM**

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TABLE 6 (Continued)

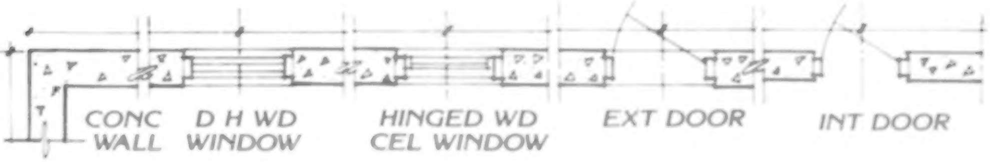
Sanitary	SAN	Tongue and groove	T & G
Scale	SC	Total	TOT.
Schedule	SCH	Tread	TR
Section	SECT	Typical	TYP
Service	SERV	Vacuum	VAC
Sewer	SEW.	Valve, volt	V
Sheathing	SHTHG	Vent pipe	VP
Shower	SH	Vertical	VERT
Side, sink, south	S	Volume	VOL
Specifications	SPEC	Waste, watt, west, width	W
Square	SQ	Water closet	WC
Stairs, steam, street	ST	Water heater	WH
Standard	STD	Waterproofing	WP
Steel	STL	Weather stripping	WS
Storage	TG	Weep hole	WH
Structural	TR	Weight	WT
Switch	SW	Welded wire fabric	WWF
Tangent	AN.	Window	WDW
Temperature	TMP	Without	W/O
Terra cotta	TC	Wood	WD
Thermostat	THERMO	Wrought iron	WI
Toilet, TEE	T		

INFORMATION SHEET

XI. Representations of conventions used by architects (Figures 10-16)

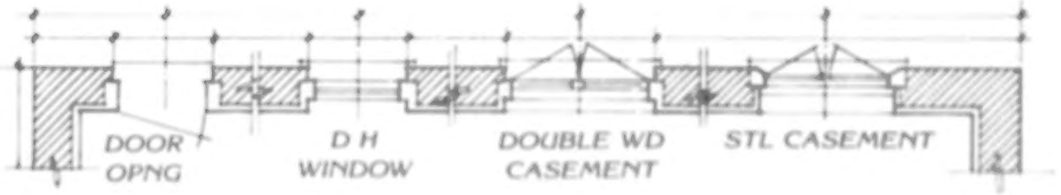
A. Doors and windows in concrete wall

FIGURE 10


CONC
WALL
D H WD
WINDOW
HINGED WD
CEL WINDOW
EXT DOOR
INT DOOR

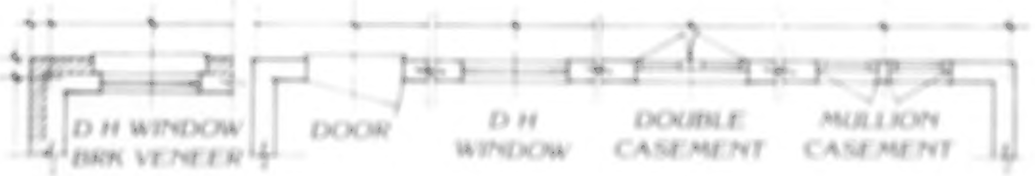
B. Doors and windows in solid brick wall

FIGURE 11


DOOR
OPNG
D H
WINDOW
DOUBLE WD
CASEMENT
STL CASEMENT

C. Doors and windows in brick veneer and wood stud walls

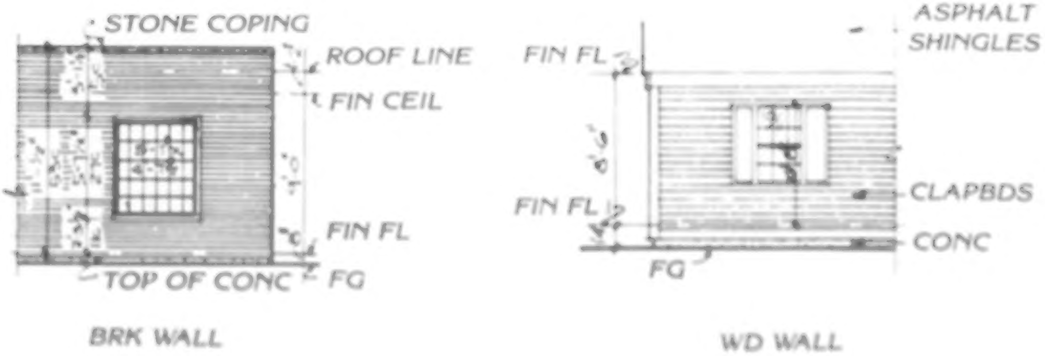
FIGURE 12


D H WINDOW
BRK VENEER
DOOR
D H
WINDOW
DOUBLE
CASEMENT
MULLION
CASEMENT

INFORMATION SHEET

D. Window elevations

FIGURE 13

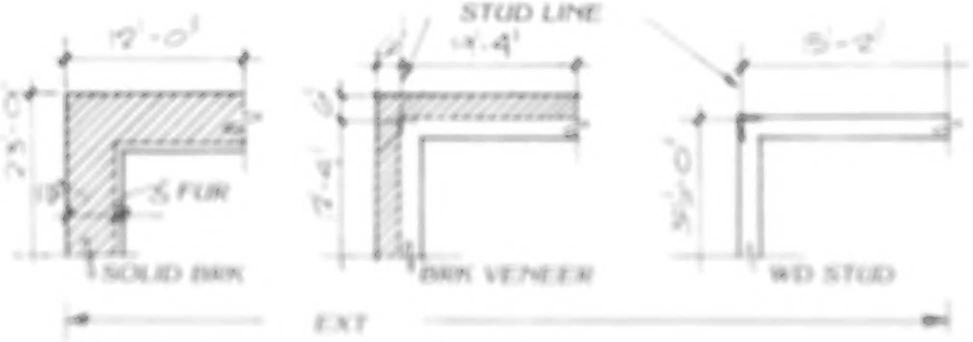

STONE COPING
ROOF LINE
FIN CEIL
FIN FL
TOP OF CONC
FG
ASPHALT SHINGLES
FIN FL
FIN FL
CLAPBDS
CONC
FG

BRK WALL

WD WALL

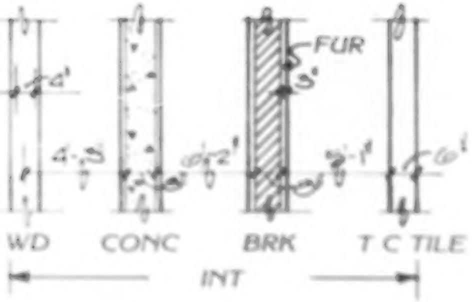
E. Dimensioning exterior and interior walls

FIGURE 14


12'-0"
23'-0"
⅝ FUR
STUD LINE
7'-4"
5'-2"
5'-0"
SOLID BRK
BRK VENEER
WD STUD
EXT

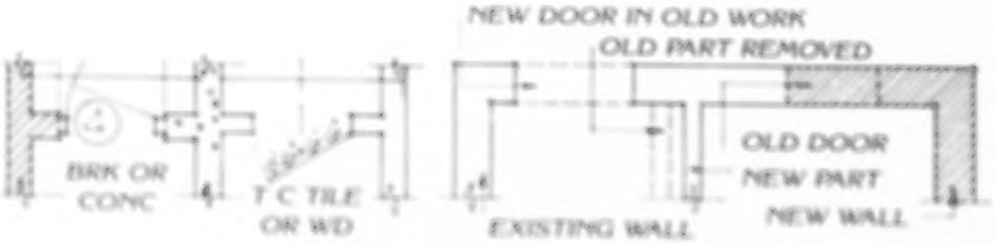
INFORMATION SHEET

FIGURE 15


FUR
4"
3"
4-5
6-2"
5-1"
6"
WD
CONC
BRK
T C TILE
INT

F. Interior dimensions and alterations

FIGURE 16


NEW DOOR IN OLD WORK
OLD PART REMOVED
OLD DOOR
NEW PART
NEW WALL
EXISTING WALL
BRK OR CONC
T C TILE OR WD

XII. Purposes of written specifications

(NOTE: Written specifications are equally as important as the drawings in a set of plans. They furnish what the drawings cannot, in that they give detailed and accurate written descriptions of work to be done, including quality and quantity of materials, methods of construction, standards of construction, and manner of conducting the work. See Assignment Sheet #2 at the end of the Information Sheet for materials specifications.)

A. Avoiding disputes among builders, architects, and owners by leaving no room for misinterpretation or misunderstanding

B. Facilitating the checking of materials and workmanship during time that building is being constructed

C. Enabling contractors to make bids based on total materials and labor required

D. Avoiding expensive omissions when estimating total costs

E. Avoiding conflicting opinions during construction and avoiding the added costs and delays that could result

INFORMATION SHEET

XIII. Basic information included in a set of written specifications

- A. Contract
- B. General requirements
- C. Owner's name and address
- D. Architect's name
- E. Location of structure
- F. Completion date
- G. Contractor's bid form
- H. Guarantees
- I. Insurance requirements
- J. Methods of construction
- K. Sizes
- L. Tolerances
- M. Types, quality, and descriptions of materials

  EXAMPLES: Type of reinforcing steel, type and strength of concrete, types of masonry, accessories and mortars, type and weight of roofing and types and values of insulation

XIV. Reading an architect's scale

- A. Determine scale to be used

  (NOTE: The scale used will be that to which the plan is drawn or one you have chosen if you are making a drawing.)

- B. Locate the required scale on the architect's scale

  EXAMPLES: 3/16", 1/4", 1"

  (NOTE: The whole or fractional number shown at the ends of an architect's scale shows the scales marked for that side. Thus, 3/16 designates a scale of 3/16" = 1' – 0". The marks for a 3/16-inch scale are 3/16 of an inch apart, with each mark representing 1 foot of distance on the drawing.)

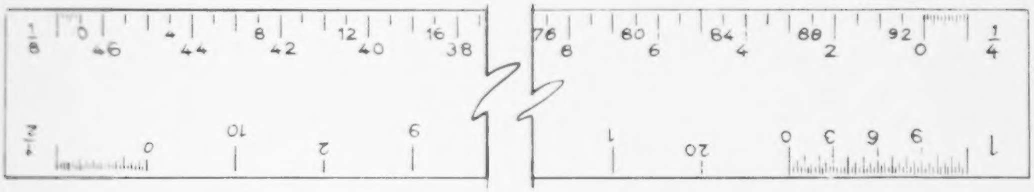
- C. Determine direction in which required scale is read

  (NOTE: Each scale is numbered, beginning near the number that designates the scale used, and is read toward the opposite end. For example, in Figure 17, the 1/8-inch scale begins at the left end and is read to the right. The 1/4-inch scale begins at the right end and is read to the left.)

INFORMATION SHEET

EXAMPLE:

FIGURE 17


1/8
0
4
8
12
16
46
44
42
40
38
76
80
84
88
92
8
6
4
2
0
1/4

D. Locate the zero mark for the required scale

(NOTE: The distance between the zero mark and the scale designation is subdivided to show inches or fractions of inches at that scale. Foot designations are aligned with the zero mark.)

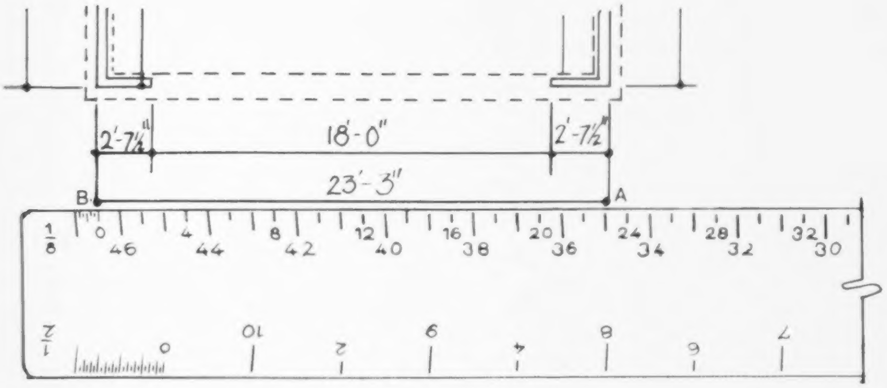
E. Measure the distance on the plan

EXAMPLE: Measure the width of the garage in Figure 18, using a scale of 1/8" = 1'-0".

1. Align the largest possible foot mark with one reference point, with other reference point falling within the scale's inch subdivisions (Figure 18)

   EXAMPLE:

FIGURE 18


2'-7½"
18'-0"
2'-7½"
23'-3"
B
A
1/8
0
4
8
12
16
20
24
28
32
46
44
42
40
38
36
34
32
30

2. Note the value of the foot mark
3. Add to the foot value the value of the inch subdivisions

   EXAMPLE: The distance measured in Figure 18 is 23'-3" because the distance from the zero mark to Point A is 23 feet, and the distance from the zero mark to Point B is 3 inches.

BASIC PLAN READING
UNIT IV

ASSIGNMENT SHEET #1 — READ PLANS

NAME ____________________ SCORE ____________

A construction worker learns to read plans by learning what information each type of drawing in a set of plans contains, by learning the meanings of the architectural terms used for each part of a building, by understanding the many abbreviations used in plans, by learning to visualize plans drawn to scales that are only fractional parts of full size, by being thoroughly acquainted with all dimensioning procedures, and by being able to recognize the many types of lines used on plans. Once you have learned these basics, you will be able to visualize. Each mark on the plan will mean something to you, just as the letters of the alphabet mean something when you are reading this paragraph.

This assignment sheet is designed to help you become more familiar with the different drawings in a set of plans. It should also give you an idea of what to look for when reading plans, and should provide practice for learning the fundamentals of plan reading. Refer to the set of plans at the end of this assignment sheet to answer the following questions. Remember that you may have to refer to detail and section drawings to answer all questions about a plan.

As you read the plans, remember that the scales shown are the original scales used in making the drawings. The plans have been reduced, and the scales are no longer accurate for the new size.

A. Plot plan

____________ 1. What are the overall outside dimensions of the building?

____________ 2. What is the elevation of the benchmark?

____________ 3. What is the width and length of the drive?

____________ 4. In what direction does the residence face?

____________ 5. How far is the residence from the east property line?

____________ 6. What is the width of the sidewalk?

____________ 7. How far is the northeast corner of the residence from the north property line?

____________ 8. How far is the southwest corner of the residence from the south property line?

____________ 9. What is the finish floor elevation?

____________ 10. What is the original scale of this drawing?

ASSIGNMENT SHEET #1

B. Foundation plan

________________________1. How thick is the concrete slab in the garage?

________________________2. What size and type of reinforcing is used in the building slab?

________________________3. How wide is the footing on the building?

________________________4. How wide are the stem walls?

________________________5. What is the drop from finish grade to the porch slab?

________________________6. What strength of concrete is used?

________________________7. How many reinforcing rods are used in the exterior footings?

________________________8. What is the radius of the edge of the garage floor at the door?

________________________9. What size anchor bolts are to be used throughout?

________________________10. How much is the garage floor sloped from the inside wall out?

________________________11. What type of insulation is used for the vapor barrier?

________________________12. In which detail are the stem wall and the floor poured monolithic?

________________________13. What is the depth of the fireplace footing?

________________________14. On which details do you find expansion joints?

________________________15. What material is used as fill beneath the concrete slab?

C. Floor plan

________________________1. What is the size of bedroom #2?

________________________2. What is the height of the fireplace hearth?

________________________3. What material is used around the perimeter of the garage?

________________________4. What is the width of the master bedroom?

________________________5. What is the thickness of the expansion material used in garage?

ASSIGNMENT SHEET #1

________________ 6. How many square feet of living space will there be?

________________ 7. How much drop is there from the garage floor to the apron?

________________ 8. What is the thickness of the exterior walls?

________________ 9. What are the dimensions of the utility room?

________________ 10. What is the size of the patio?

________________ 11. What are the dimensions of the planter?

________________ 12. What is the radius of the curved edges of the patio?

________________ 13. Of what material is the planter made?

________________ 14. What is the thickness of the garage floor?

D. Electrical floor plan

________________ 1. How many duplex receptacle outlets are in the master bedroom?

________________ 2. What type switches control the ceiling incandescent light in garage?

________________ 3. What special type outlet is used in the utility room?

________________ 4. What type of switch is used in the master bedroom closet?

________________ 5. How many special types of outlets are in the living room?

________________ 6. What type of light is used in the entry?

________________ 7. What type of lights are used on the porch?

________________ 8. Are there any duplex weatherproof outlets used on this structure? If so, how many are there?

________________ 9. Where and in what room is the lighting panel located? (Be specific.)

________________ 10. What is the total number of outlets in bedroom #2?

E. HVAC floor plan

________________ 1. How many floor registers are in each bathroom?

________________ 2. Where is the return air register located? (Be specific.)

ASSIGNMENT SHEET #1

____________________3. What size duct is used coming from the furnace to the kitchen?

____________________4. How many floor registers are in the entire structure?

____________________5. What size duct is used in the master bedroom?

____________________6. How many sizes of duct are used in the building?

____________________7. In what room is the thermostat located?

____________________8. Where is the air conditioner unit located? (Be specific.)

____________________9. What is the size of the duct that supplies bedrooms #2 and #3?

____________________10. How many 6-inch branch lines are there?

F. Plumbing floor plan

____________________1. Where is the water meter located? (Be specific.)

____________________2. How many hose bibbs are there on the outside of the building?

____________________3. In what direction is the sewer from the house?

____________________4. What is the size of the main sewer line?

____________________5. What type of lines run to the yard light?

____________________6. How many appliances are serviced by gas?

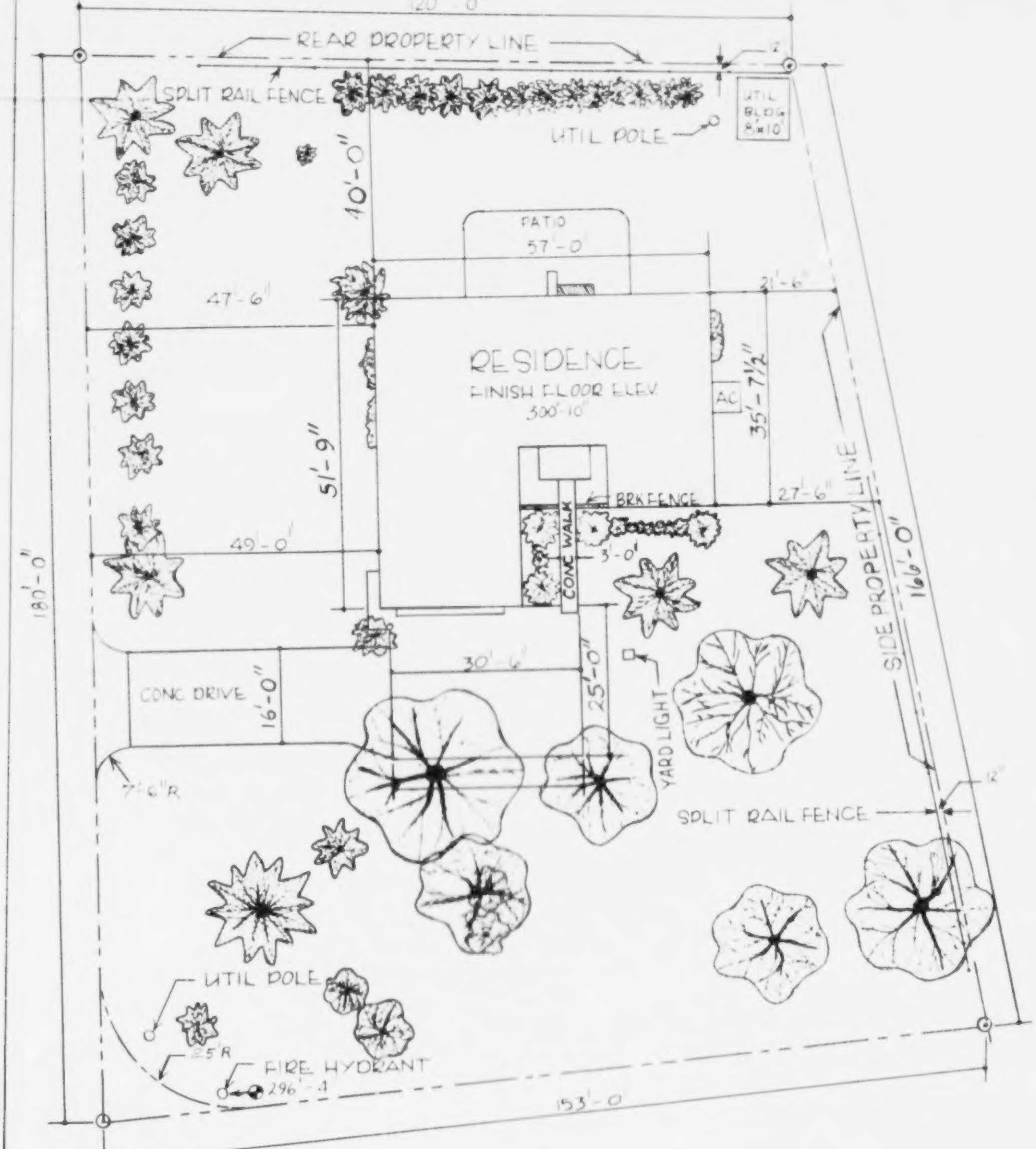
____________________7. How many gas outlets are shown on the plan?

____________________8. What is the size of the main water line?

____________________9. Through which room does the gas supply enter the building?

____________________10. What does the symbol CO|├ stand for?

ASSIGNMENT SHEET #1

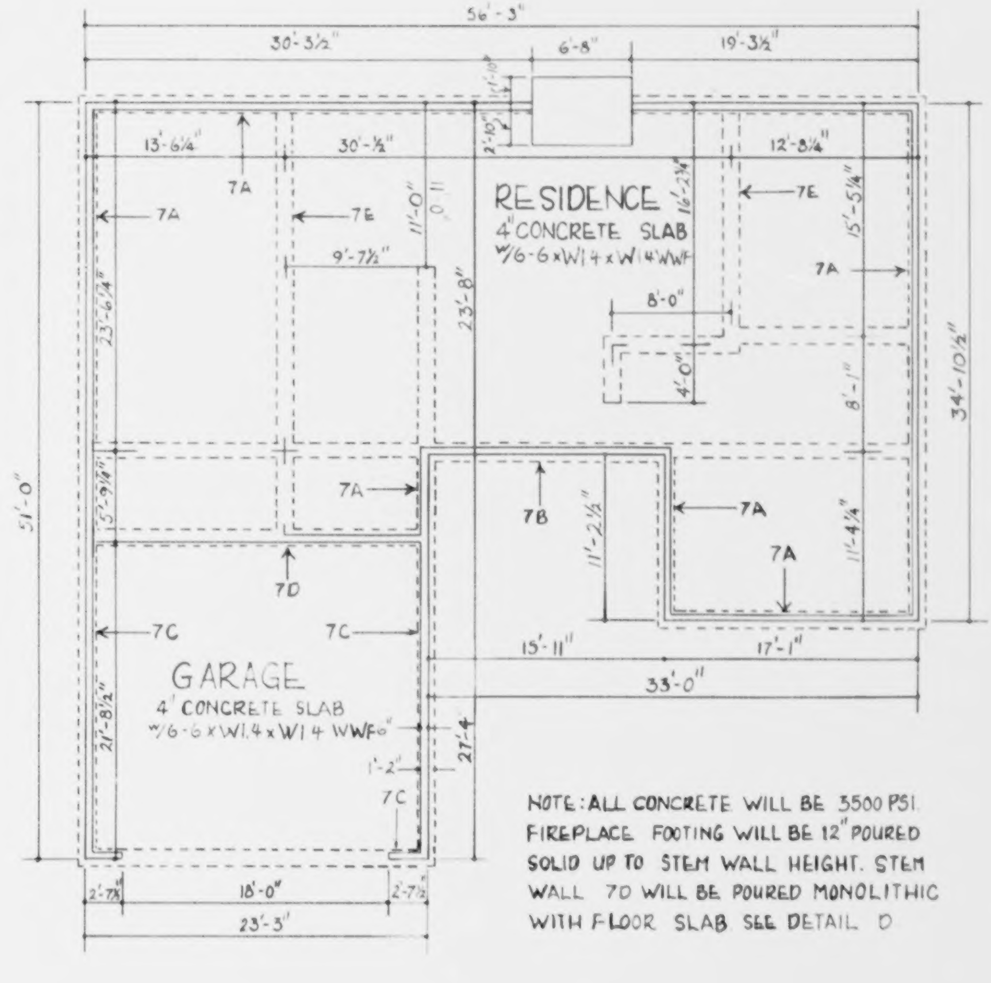

120'-0"
REAR PROPERTY LINE
12"
SPLIT RAIL FENCE
UTIL BLDG 8'x10'
UTIL POLE
10'-0"
PATIO
57'-0"
47'-6"
21'-6"
RESIDENCE
FINISH FLOOR ELEV.
300'-10"
AC
35'-7½"
51'-9"
BRK FENCE
27'-6"
49'-0"
CONC WALK
3'-0"
SIDE PROPERTY LINE
166'-0"
180'-0"
30'-6"
25'-0"
YARD LIGHT
CONC DRIVE
16'-0"
7'-6"R
SPLIT RAIL FENCE
12"
UTIL POLE
25'R
FIRE HYDRANT
296'-4
153'-0"

PLOT PLAN

SCALE :- 1" = 20'-0"

N

ASSIGNMENT SHEET #1


56'-3"
30'-3½"
6'-8"
19'-3½"
1'-10"
2'-10"
13'-6¼"
30'-½"
12'-8¼"
7A
7E
11'-0"
RESIDENCE
4" CONCRETE SLAB
W/6-6xW1.4xW1.4WWF
16'-2¾"
15'-5¼"
9'-7½"
23'-8"
23'-6¼"
8'-0"
4'-0"
8'-1"
34'-10½"
51'-0"
5'-9¼"
7B
11'-2½"
11'-4¼"
15'-11"
17'-1"
33'-0"
7D
7C
GARAGE
4" CONCRETE SLAB
W/6-6xW1.4xW1.4 WWF
6"
21'-8½"
27'-4
1'-2"
2'-7½"
18'-0"
23'-3"

NOTE: ALL CONCRETE WILL BE 3500 PSI. FIREPLACE FOOTING WILL BE 12" POURED SOLID UP TO STEM WALL HEIGHT. STEM WALL 7D WILL BE POURED MONOLITHIC WITH FLOOR SLAB SEE DETAIL D

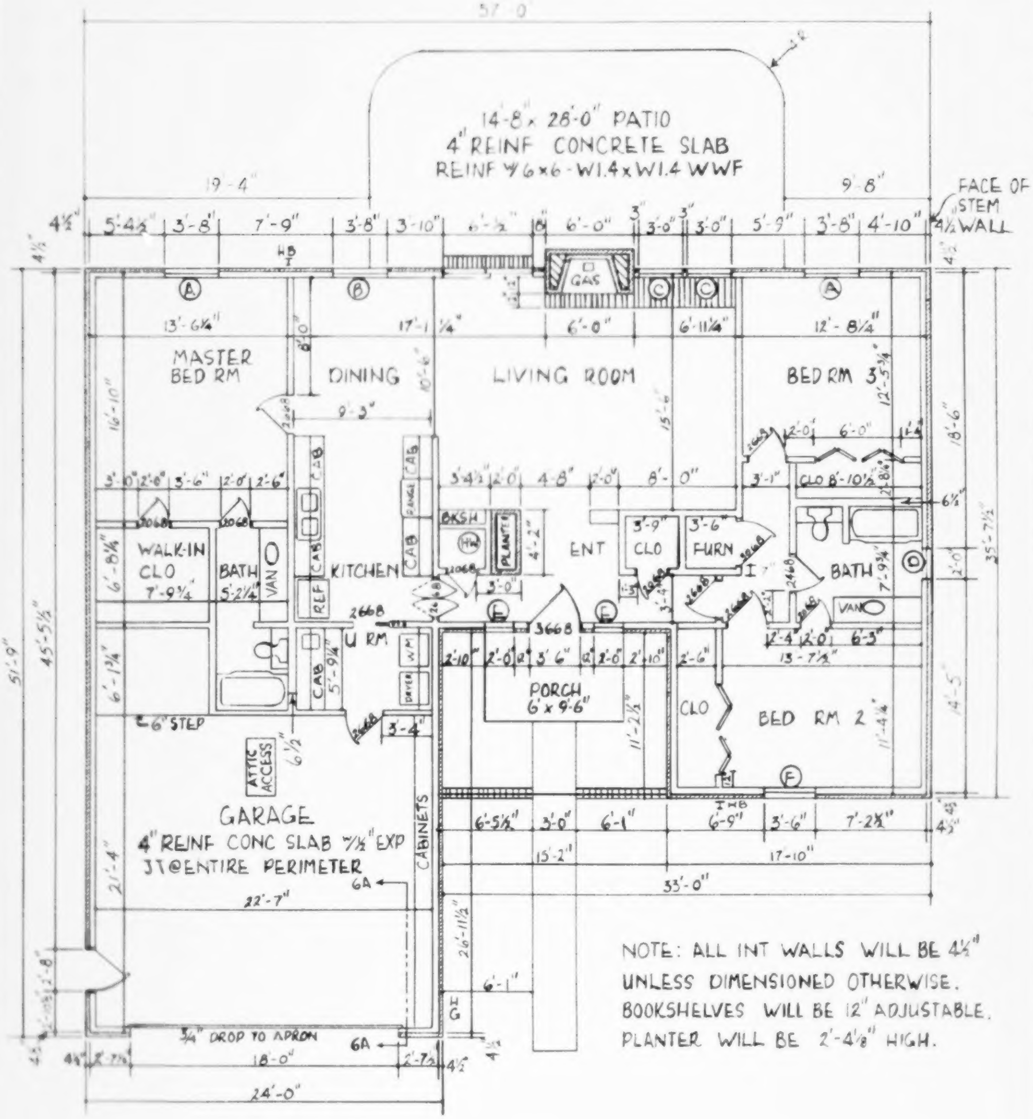
FOUNDATION PLAN

SCALE :- 1/8" = 1'-0"

N

SHEET 2

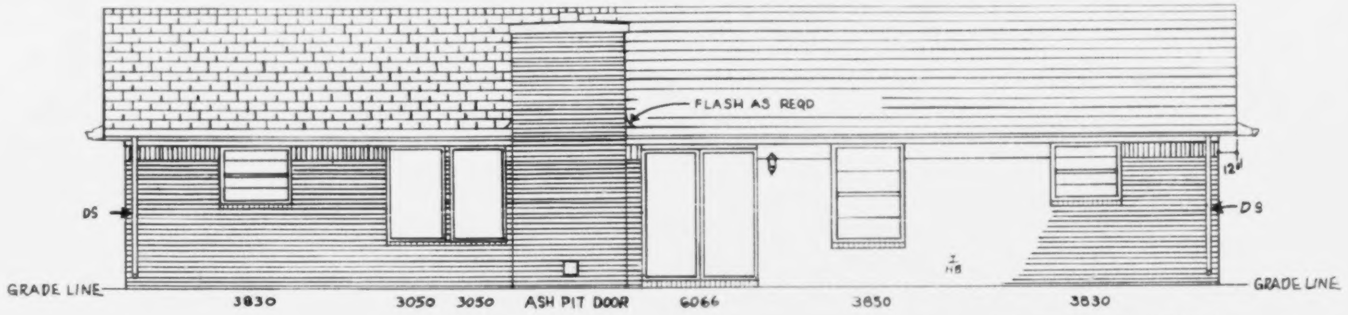
ASSIGNMENT SHEET #1


57'-0"
14'-8" x 28'-0" PATIO
4" REINF CONCRETE SLAB
REINF W/ 6x6 - W1.4 x W1.4 WWF
19'-4"
9'-8"
FACE OF STEM WALL
4½"
5'-4½"
3'-8"
7'-9"
3'-8"
3'-10"
6'-0"
3'-0"
3'-0"
5'-9"
3'-8"
4'-10"
HB
GAS
13'-6¼"
17'-1¼"
6'-0"
6'-11¼"
12'-8¼"
MASTER BED RM
DINING
LIVING ROOM
BED RM 3
16'-10"
10'-6"
15'-6"
12'-5¾"
18'-6"
9'-3"
2068
3'-0" 2'-6" 3'-6" 2'-0" 2'-6"
3'-4½" 2'-0" 4'-8" 2'-0" 8'-0"
3'-1"
CLO 8'-10½"
2'-0" 6'-0" 1'-4"
6½"
WALK-IN CLO
7'-9¼"
6'-8¼"
BATH
5'-2¼"
VAN
CAB
RANGE
REF
KITCHEN
BKSH
HW
PLANTER
4'-2"
3'-0"
ENT
3'-9"
CLO
3'-6"
FURN
BATH
7'-9¾"
2'-0"
35'-7½"
VAN
2468
2668
3668
U RM
W/M
DRYER
5'-9¼"
6'-1¾"
2'-10" 2'-0" 3'-6" 2'-0" 2'-10"
2'-6"
2'-4" 2'-0" 6'-3"
13'-7½"
PORCH
6' x 9'-6"
11'-2½"
CLO
BED RM 2
11'-4¼"
14'-5"
6" STEP
ATTIC ACCESS
6½"
3'-4"
GARAGE
4" REINF CONC SLAB W/ ½" EXP JT @ ENTIRE PERIMETER
CABINETS
6'-5½" 3'-0" 6'-1" 6'-9" 3'-6" 7'-2¾"
15'-2"
17'-10"
33'-0"
21'-4"
22'-7"
6A
51'-9"
45'-5½"
26'-11½"
2'-8"
6'-1"
G
¾" DROP TO APRON
18'-0"
2'-7½"
24'-0"

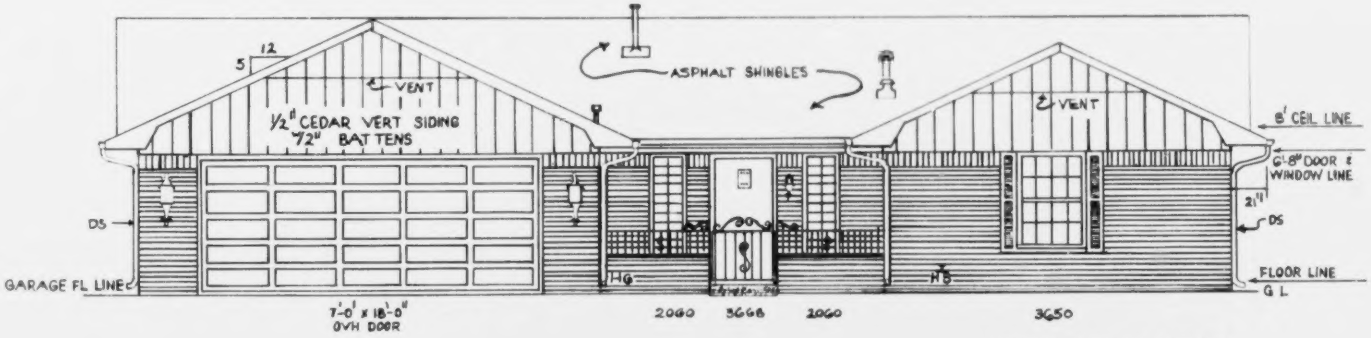
NOTE: ALL INT WALLS WILL BE 4½" UNLESS DIMENSIONED OTHERWISE. BOOKSHELVES WILL BE 12" ADJUSTABLE. PLANTER WILL BE 2'-4⅛" HIGH.

FLOOR PLAN

SCALE :- ⅛" = 1'-0"


FLASH AS REQD
12"
DS
DS
GRADE LINE
GRADE LINE
3830
3050
3050
ASH PIT DOOR
6066
3850
3830
HB

EAST ELEVATION


5
12
VENT
1/2" CEDAR VERT SIDING
1/2" BATTENS
ASPHALT SHINGLES
VENT
8' CEIL LINE
6'-8" DOOR & WINDOW LINE
2'1"
DS
DS
FLOOR LINE
G L
GARAGE FL LINE
HB
HB
7'-0" x 18'-0" OVH DOOR
2060
3668
2060
3650

WEST ELEVATION

ASSIGNMENT SHEET #1

SHEET 4

ELEVATION PLAN

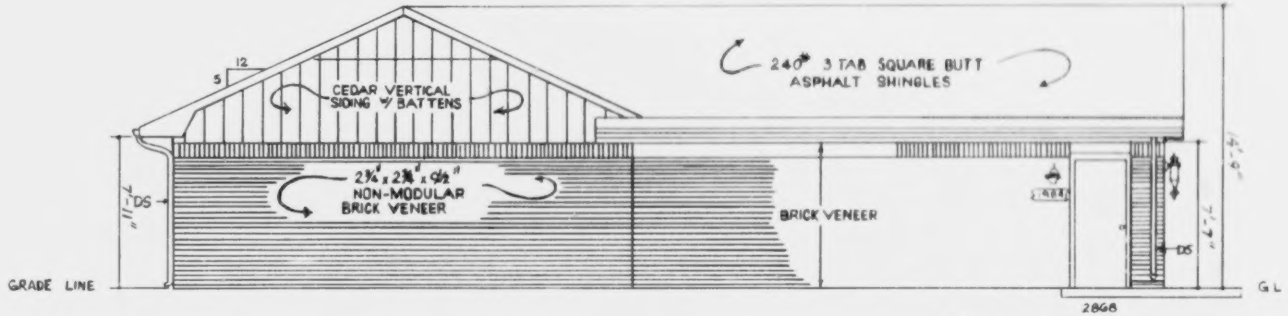
SCALE :-3/16"=1'-0" N

FOC-327-B

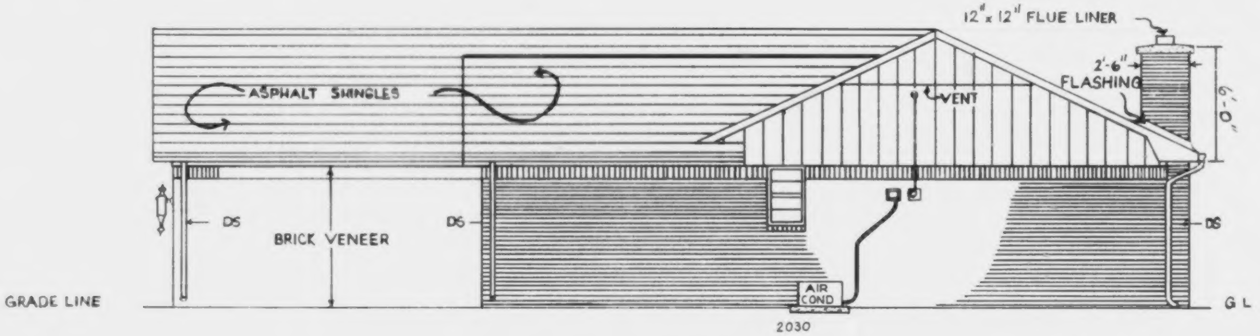
490

491

ASSIGNMENT SHEET #1


12
5
CEDAR VERTICAL SIDING W/ BATTENS
240# 3 TAB SQUARE BUTT ASPHALT SHINGLES
2¼" x 2¾" x 9½" NON-MODULAR BRICK VENEER
DS
7'-11"
BRICK VENEER
14'-0"
7'-7"
DS
GRADE LINE
G L
2868

NORTH ELEVATION


12" x 12" FLUE LINER
2'-6"
FLASHING
6'-0"
ASPHALT SHINGLES
VENT
DS
BRICK VENEER
DS
DS
GRADE LINE
G L
AIR COND
2030

SOUTH ELEVATION

ELEVATION PLAN

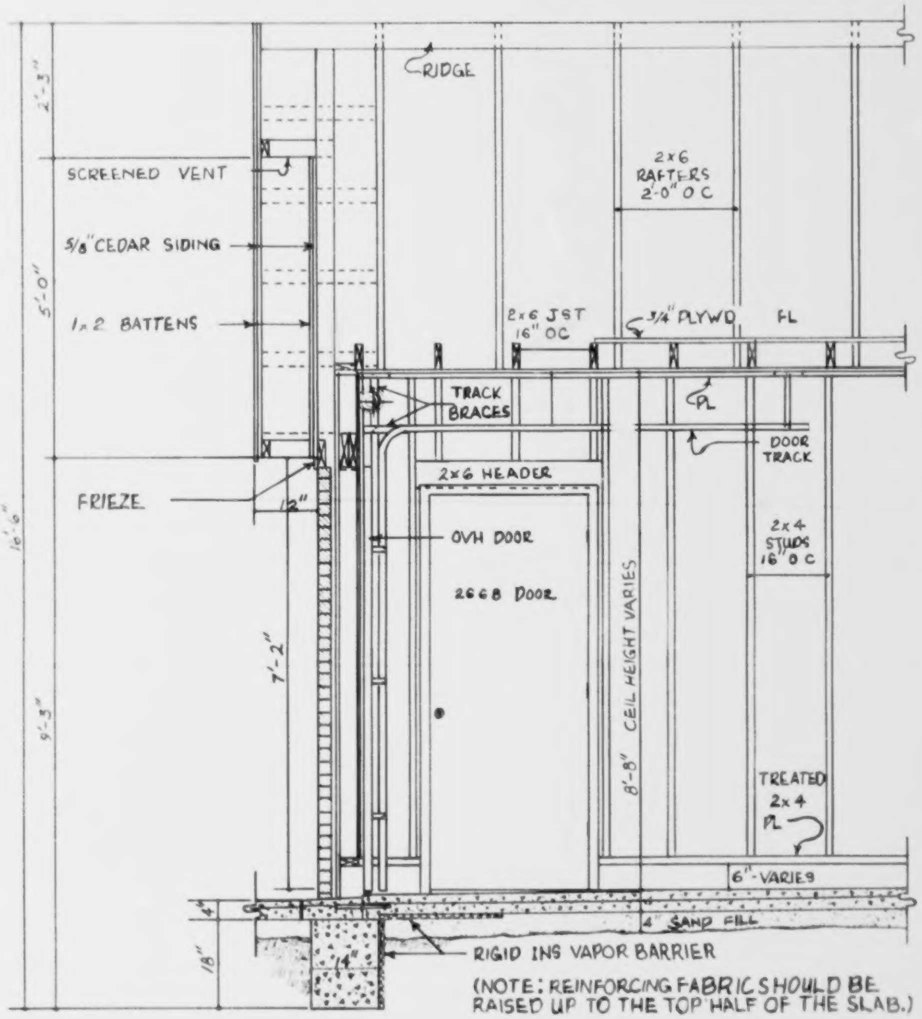
CONTINUED

SCALE :- 3/16" = 1'-0"

SHEET 5

FOC-323-B

ASSIGNMENT SHEET #1


RIDGE
2x6 RAFTERS 2'-0" O C
SCREENED VENT
5/8" CEDAR SIDING
1x2 BATTENS
2x6 JST 16" OC
3/4" PLYWD FL
PL
TRACK BRACES
DOOR TRACK
2x6 HEADER
FRIEZE
12"
OVH DOOR
2668 DOOR
2x4 STUDS 16" O C
CEIL HEIGHT VARIES
8'-8"
TREATED 2x4 PL
6"-VARIES
4" SAND FILL
RIGID INS VAPOR BARRIER
2'-3"
5'-0"
10'-6"
9'-3"
7'-2"
4"
18"
14"

(NOTE: REINFORCING FABRIC SHOULD BE RAISED UP TO THE TOP HALF OF THE SLAB.)

FLOOR SLOPED 2" FROM INSIDE WALL OUT.

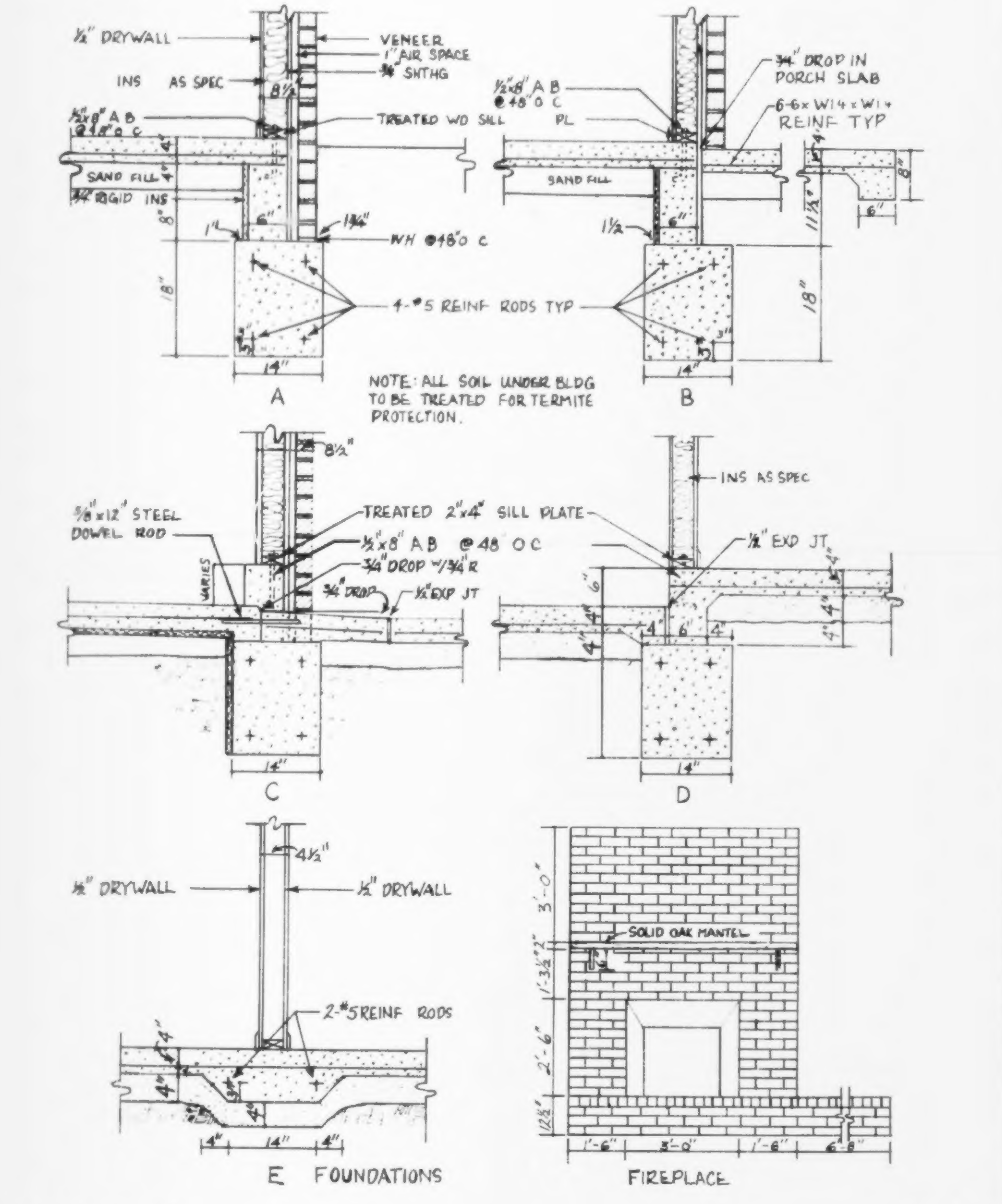
SECTION AA

SECTION DRAWING

SCALE :- 1/2" = 1'-0"

SHEET 6

ASSIGNMENT SHEET #1


½" DRYWALL
INS AS SPEC
½"x8" A B @ 48" O C
8½"
VENEER
1" AIR SPACE
¾" SHTHG
TREATED WD SILL
SAND FILL
¾" RIGID INS
4"
4"
8"
1"
6"
1¾"
WH @ 48" O C
18"
4-#5 REINF RODS TYP
14"
A
NOTE: ALL SOIL UNDER BLDG TO BE TREATED FOR TERMITE PROTECTION.
½"x8" A B @ 48" O C
PL
¾" DROP IN PORCH SLAB
6-6 x W1.4 x W1.4 REINF TYP
SAND FILL
1½
6"
18"
3"
14"
11½"
8"
6"
B
8½"
⅝"x12" STEEL DOWEL ROD
VARIES
TREATED 2"x4" SILL PLATE
½"x8" A B @ 48 O C
¾" DROP w/ ¾" R
¾" DROP
½" EXP JT
14"
C
INS AS SPEC
½" EXD JT
6"
4"
4"
4"
6"
4"
4"
4"
14"
D
4½"
½" DRYWALL
½" DRYWALL
2-#5 REINF RODS
4"
4"
4"
4"
14"
4"
E FOUNDATIONS
3'-0"
SOLID OAK MANTEL
2"
1'-3½"
2'-6"
1'2¼"
1'-6"
3'-0"
1'-6"
6'-8"
FIREPLACE

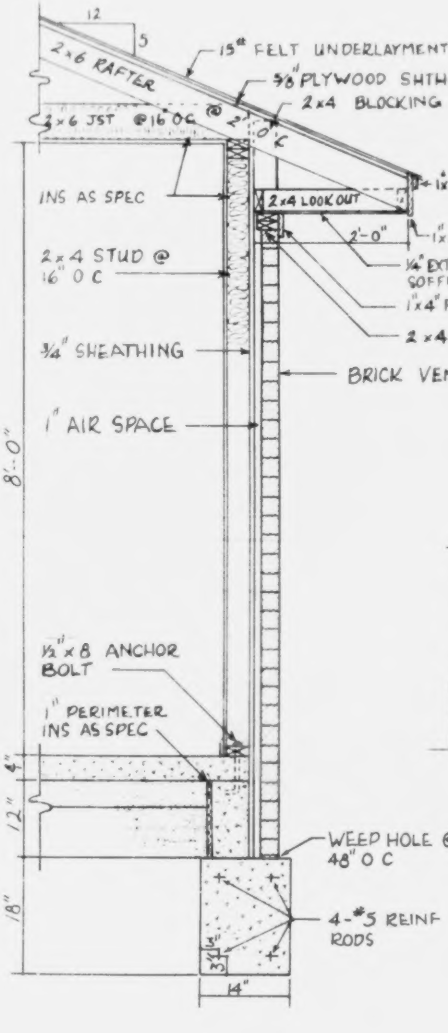
SCALE:- ¾" = 1'-0"

SCALE:- ⅜" = 1'-0"

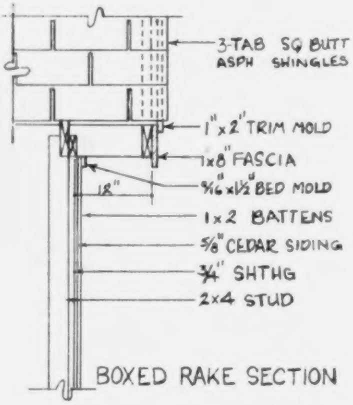
DETAILS

SHEET 7

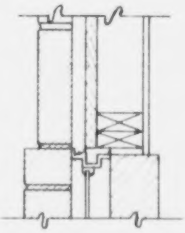
ASSIGNMENT SHEET #1


12
5
2×6 RAFTER
15# FELT UNDERLAYMENT
5/8" PLYWOOD SHTHG
2×4 BLOCKING
2×6 JST @16" OC
@ 2'-0" C
INS AS SPEC
1"×2" TRIM
2×4 LOOK OUT
2'-0"
1"×8" FASCIA
2×4 STUD @ 16" O C
1/4" EXT PLYWOOD SOFFIT
1"×4" FRIEZE
2×4 BLKG
3/4" SHEATHING
BRICK VENEER
1" AIR SPACE
8'-0"
1/2"×8 ANCHOR BOLT
1" PERIMETER INS AS SPEC
4"
12"
WEEP HOLE @ 48" O C
18"
4-#5 REINF RODS
3 1/2"
14"

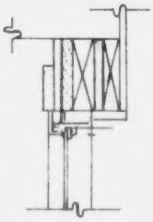
CORNICE CONST


3-TAB SQ BUTT ASPH SHINGLES
1"×2" TRIM MOLD
1×8" FASCIA
9/16"×1 1/2" BED MOLD
18"
1×2 BATTENS
5/8" CEDAR SIDING
3/4" SHTHG
2×4 STUD

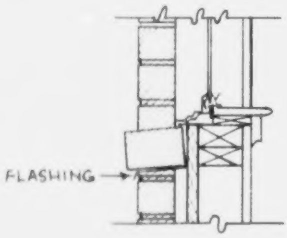
BOXED RAKE SECTION



JAMB



HEAD



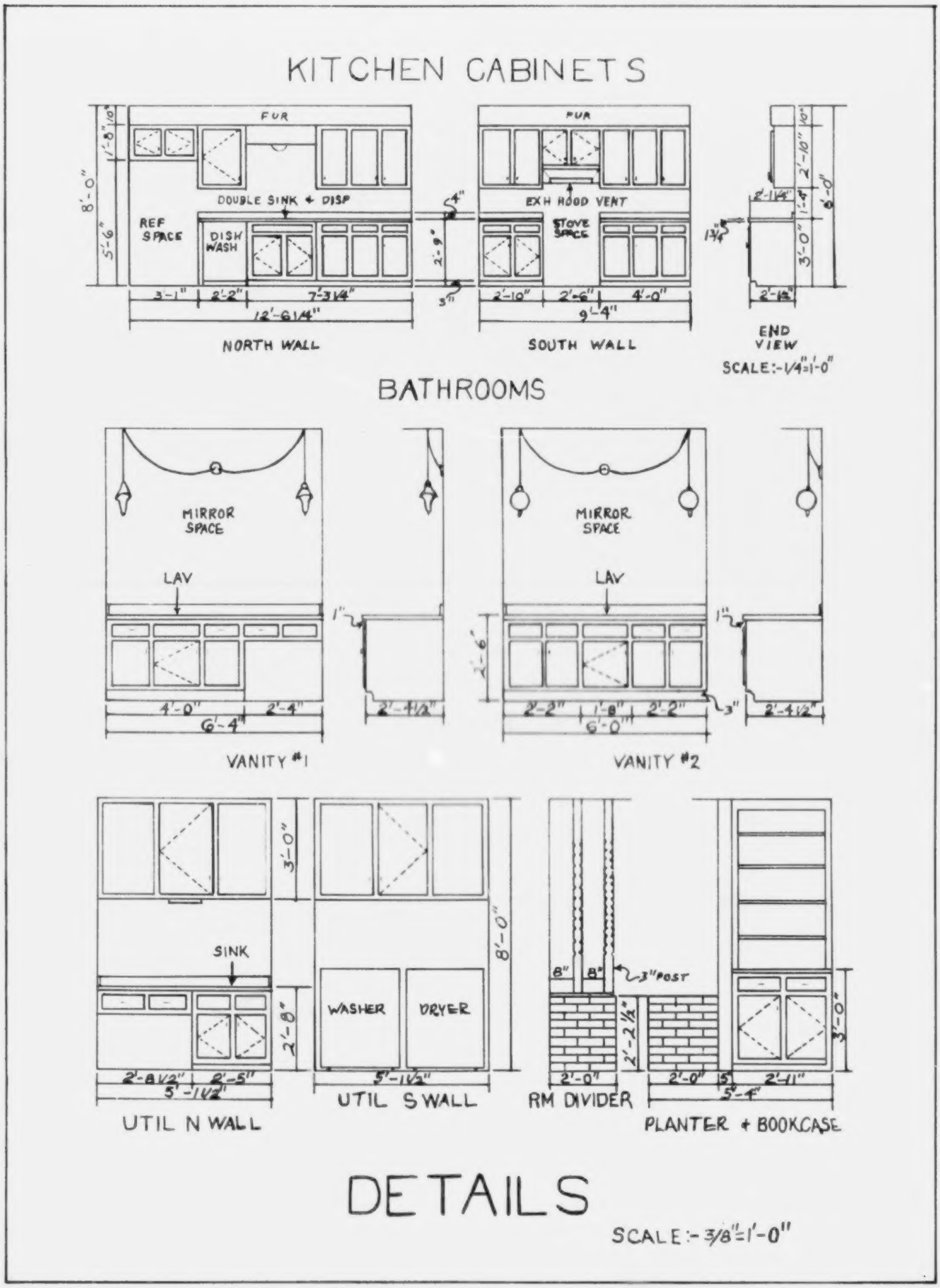
SILL

SCALE:- 3/4" = 1'-0"

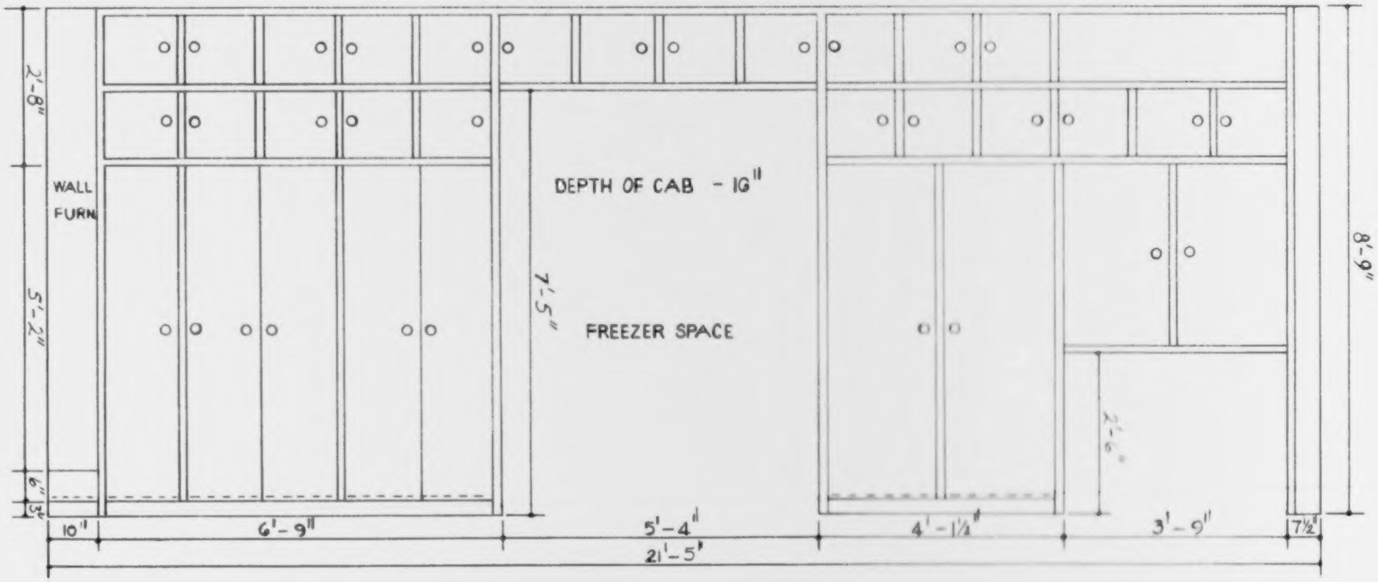
SCALE:- 1 1/2" = 1'-0"

DETAILS

ASSIGNMENT SHEET #1


KITCHEN CABINETS
FUR
FUR
1'-8"
10"
8'-0"
5'-6"
REF SPACE
DISH WASH
DOUBLE SINK + DISP
4"
2'-9"
3"
3'-1"
2'-2"
7'-3 1/4"
12'-6 1/4"
NORTH WALL
EXH HOOD VENT
STOVE SPACE
2'-10"
2'-6"
4'-0"
9'-4"
SOUTH WALL
10"
2'-10"
1'-4"
3'-0"
6'-0"
2'-1 1/4"
1 3/4"
2'-1 1/2"
END VIEW
SCALE:-1/4"=1'-0"
BATHROOMS
MIRROR SPACE
LAV
1"
4'-0"
2'-4"
6'-4"
2'-4 1/2"
VANITY #1
MIRROR SPACE
LAV
2'-6"
1"
2'-2"
1'-8"
2'-2"
6'-0"
3"
2'-4 1/2"
VANITY #2
3'-0"
SINK
2'-8"
2'-8 1/2"
2'-5"
5'-1 1/2"
UTIL N WALL
8'-0"
WASHER
DRYER
5'-1 1/2"
UTIL S WALL
8"
8"
3" POST
2'-2 1/2"
2'-0"
RM DIVIDER
2'-0"
5"
2'-11"
5'-4"
3'-0"
PLANTER + BOOKCASE
DETAILS
SCALE:-3/8"=1'-0"

SHEET 9


2'-8"
5'-2"
6"
3"
WALL
FURN
DEPTH OF CAB - 16"
7'-5"
FREEZER SPACE
2'-6"
8'-9"
10"
6'-9"
5'-4"
4'-1½"
3'-9"
7½"
21'-5"

GARAGE CABINETS

SCALE :- ½" = 1'-0"

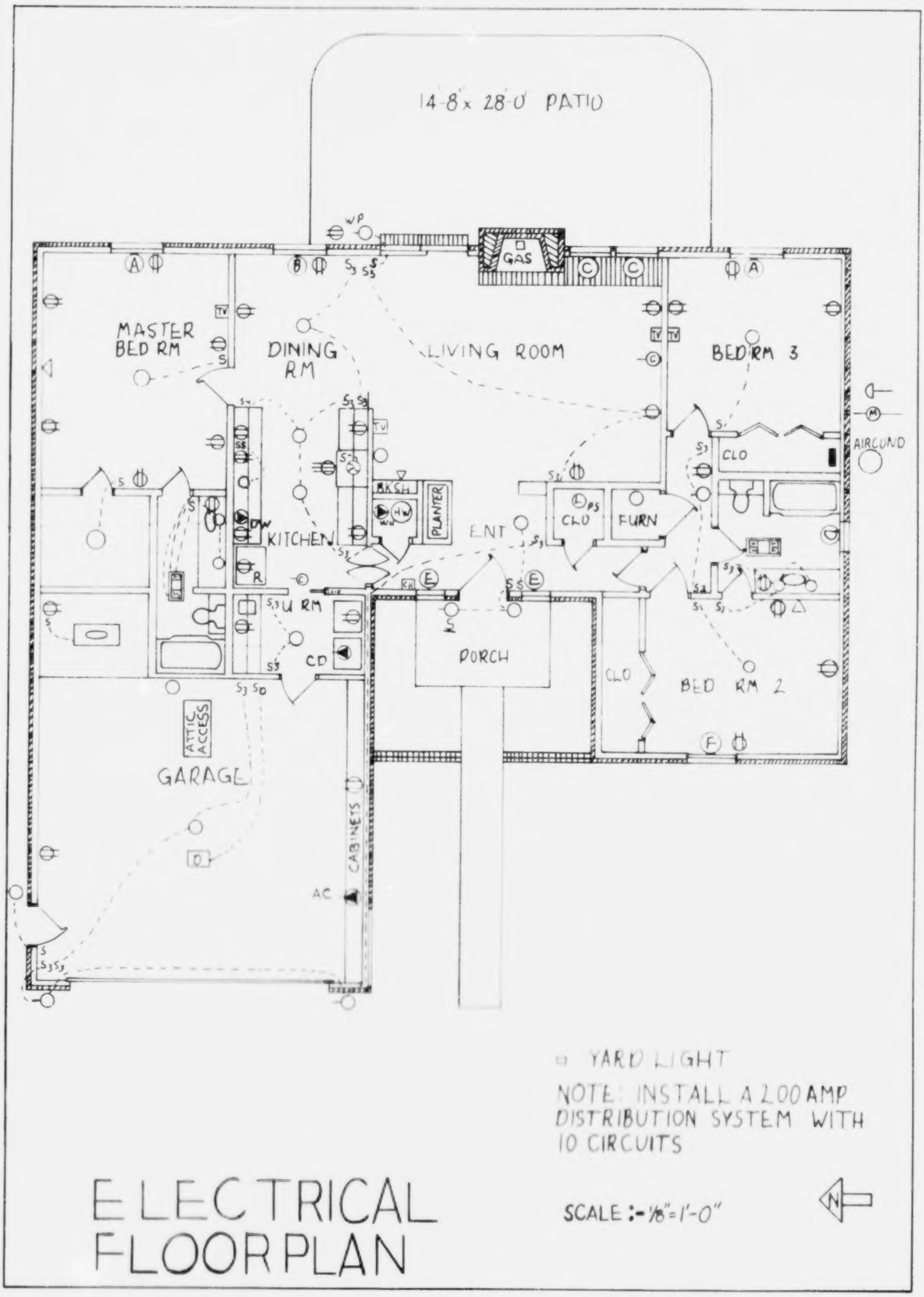
DETAILS

ASSIGNMENT SHEET #1

SHEET 10

FOC-333-B

ASSIGNMENT SHEET #1


14'-8" x 28'-0" PATIO
WP
GAS
MASTER BED RM
DINING RM
LIVING ROOM
BED RM 3
TV
CLO
AIRCOND
KITCHEN
DW
R
WH
PLANTER
ENT
CLO
FURN
U RM
CD
PORCH
CLO
BED RM 2
ATTIC ACCESS
GARAGE
CABINETS
AC
N

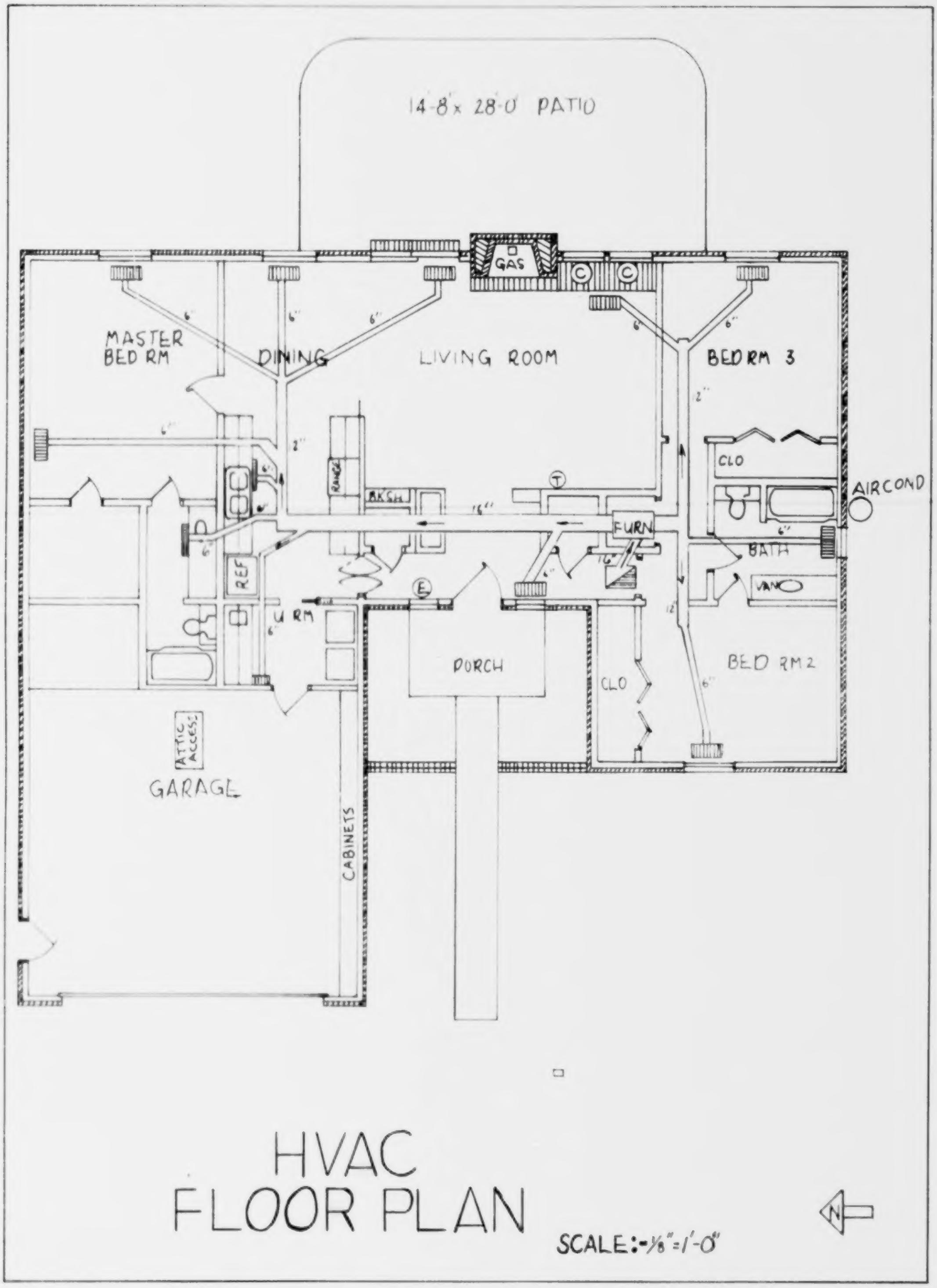
□ YARD LIGHT

NOTE: INSTALL A 200 AMP DISTRIBUTION SYSTEM WITH 10 CIRCUITS

ELECTRICAL FLOOR PLAN

SCALE :- 1/8"=1'-0"

ASSIGNMENT SHEET #1

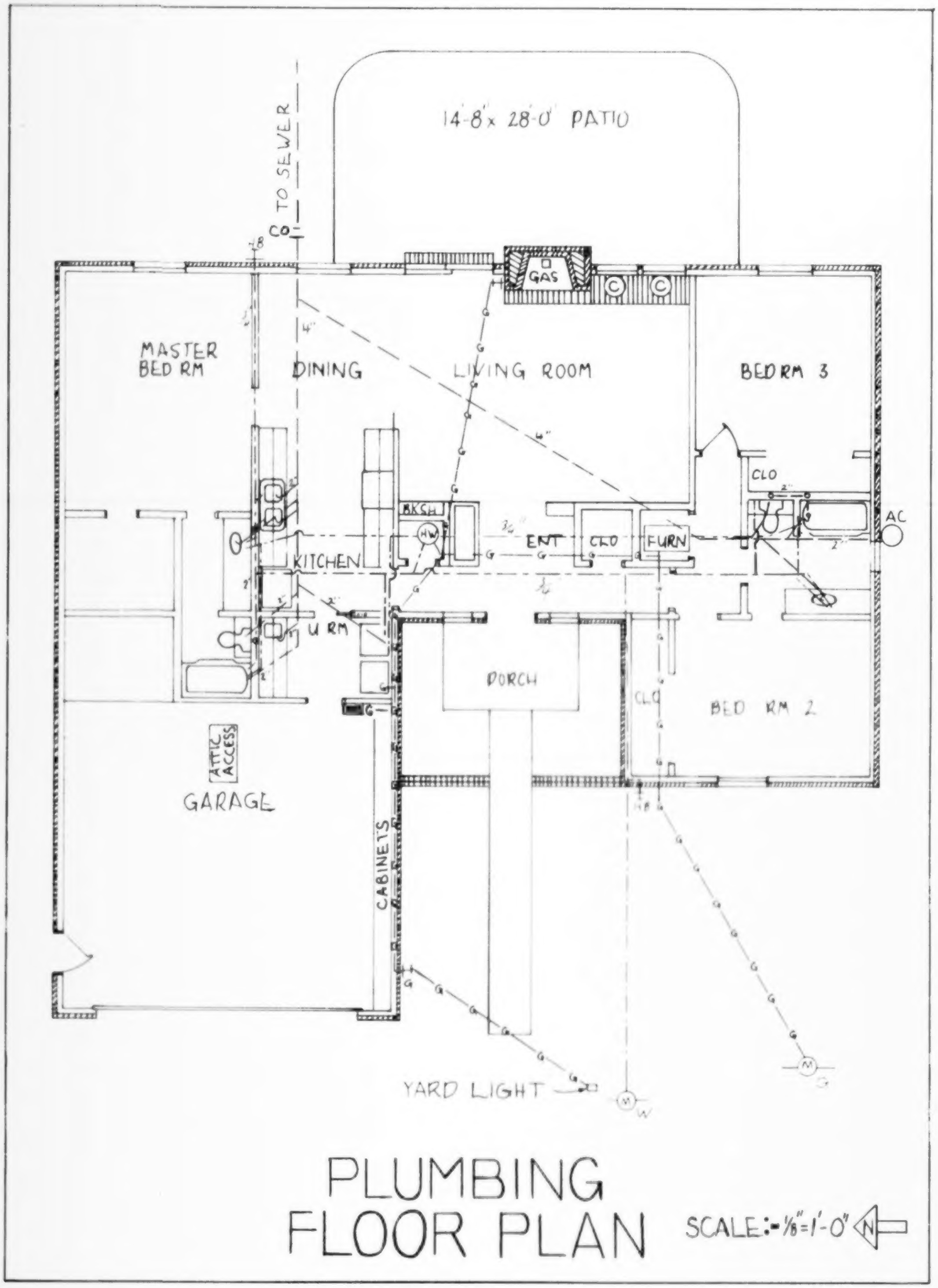

14'-8" x 28'-0" PATIO
GAS
C
C
MASTER BED RM
DINING
LIVING ROOM
BED RM 3
6"
2"
CLO
T
AIR COND
RANGE
BKSH
16"
FURN
BATH
VAN
REF
U RM
E
PORCH
CLO
12"
BED RM 2
ATTIC ACCESS
GARAGE
CABINETS
N

HVAC
FLOOR PLAN

SCALE:-1/8"=1'-0"

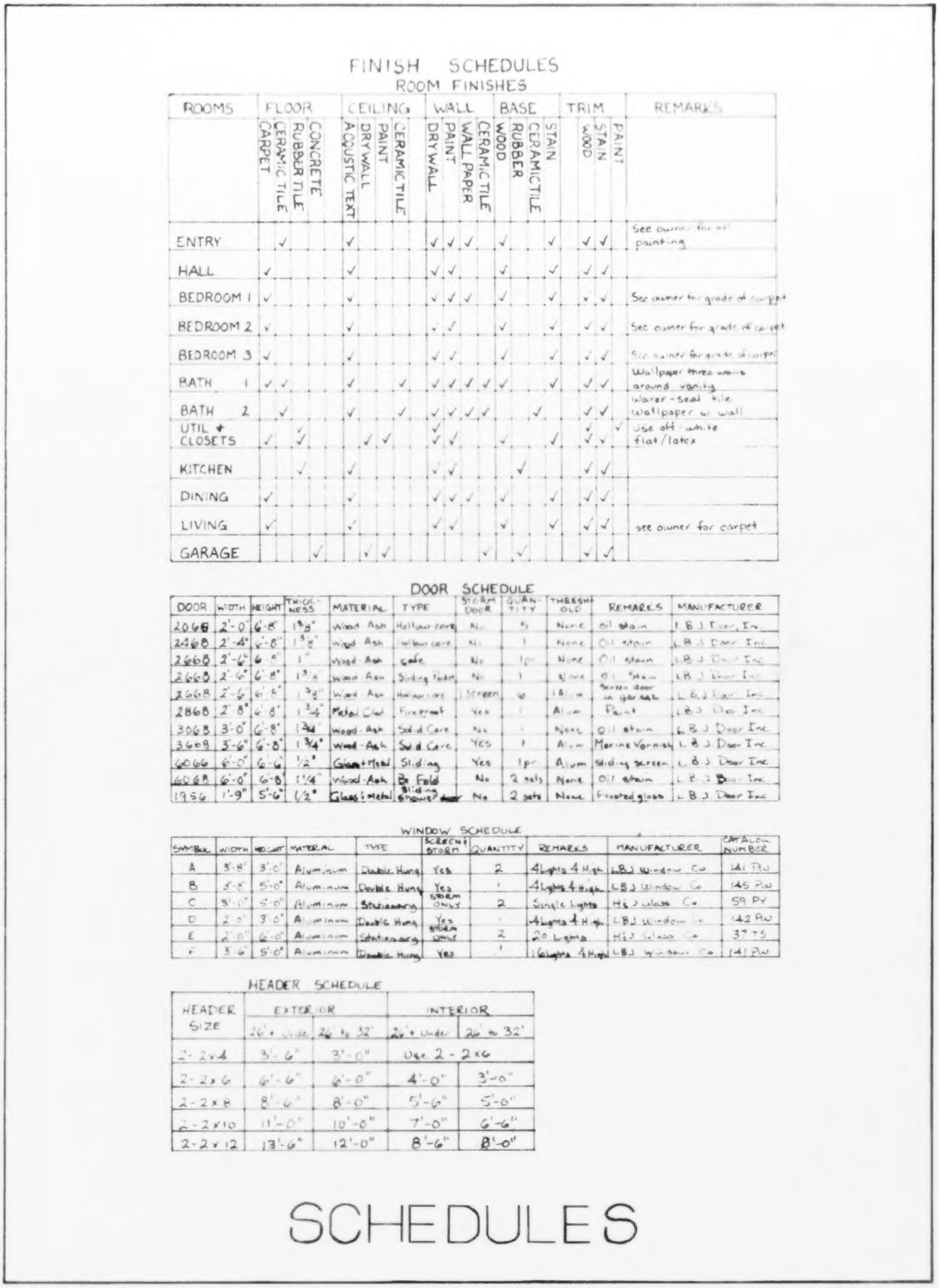
SHEET 12

ASSIGNMENT SHEET #1


14'-8" x 28'-0" PATIO
TO SEWER
CO
GAS
MASTER BED RM
DINING
LIVING ROOM
BEDRM 3
4"
6"
CLO
AC
BKSH
HW
3/4"
ENT
CLO
FURN
2"
KITCHEN
U RM
PORCH
CLO
BED RM 2
ATTIC ACCESS
GARAGE
CABINETS
YARD LIGHT
M
W
M
G
PLUMBING FLOOR PLAN
SCALE:-1/8"=1'-0"
N

SHEET 13

ASSIGNMENT SHEET #1



FINISH SCHEDULES

ROOM FINISHES

ROOMS	FLOOR					CEILING					WALL				BASE				TRIM				REMARKS
	CARPET	CERAMIC TILE	RUBBER TILE	CONCRETE		ACOUSTIC TEXT	DRYWALL	PAINT	CERAMIC TILE		DRYWALL	PAINT	WALL PAPER	CERAMIC TILE	WOOD	RUBBER	CERAMIC TILE	STAIN		WOOD	STAIN	PAINT	
ENTRY		✓				✓					✓	✓	✓		✓			✓		✓	✓		See owner for all painting
HALL	✓					✓					✓	✓			✓			✓		✓	✓		
BEDROOM 1	✓					✓					✓	✓	✓		✓			✓		✓	✓		See owner for grade of carpet
BEDROOM 2	✓					✓					✓	✓			✓			✓		✓	✓		See owner for grade of carpet
BEDROOM 3	✓					✓					✓	✓			✓			✓		✓	✓		See owner for grade of carpet
BATH 1	✓	✓				✓			✓		✓	✓	✓	✓	✓			✓		✓	✓		Wallpaper three walls around vanity
BATH 2		✓				✓			✓		✓	✓	✓	✓			✓			✓	✓		Water-seal tile wallpaper w wall
UTIL + CLOSETS	✓		✓ ✓				✓	✓			✓ ✓	✓			✓			✓		✓ ✓	✓	✓	Use off-white flat/latex
KITCHEN			✓			✓					✓	✓				✓				✓	✓		
DINING	✓					✓					✓	✓	✓		✓			✓		✓	✓		
LIVING	✓					✓					✓	✓			✓			✓		✓	✓		see owner for carpet
GARAGE				✓			✓	✓						✓		✓				✓	✓		

DOOR SCHEDULE

DOOR	WIDTH	HEIGHT	THICKNESS	MATERIAL	TYPE	STORM DOOR	QUANTITY	THRESHOLD	REMARKS	MANUFACTURER
2068	2'-0"	6'-8"	1 3/8"	Wood Ash	Hollow core	No	5	None	Oil stain	L B J Door, Inc
2468	2'-4"	6'-8"	1 3/8"	Wood Ash	Hollow core	No	1	None	Oil stain	L B J Door Inc
2668	2'-6"	6'-8"	1"	Wood-Ash	Cafe	No	1pr	None	Oil stain	L B J Door Inc
2668	2'-6"	6'-8"	1 3/8"	Wood-Ash	Sliding Pocket	No	1	None	Oil Stain	L B J Door Inc
2668	2'-6"	6'-8"	1 3/8"	Wood-Ash	Hollow core	1 Screen	6	1 Alum	Screen door in garage	L B J Door Inc
2868	2'-8"	6'-8"	1 3/4"	Metal Clad	Fireproof	Yes	1	Alum	Paint	L B J Door Inc
3068	3'-0"	6'-8"	1 3/4"	Wood-Ash	Solid Core	No	1	None	Oil stain	L B J Door Inc
3668	3'-6"	6'-8"	1 3/4"	Wood-Ash	Solid Core	YES	1	Alum	Marine Varnish	L B J Door Inc
6066	6'-0"	6'-6"	1/2"	Glass+Metal	Sliding	Yes	1pr	Alum	Sliding screen	L B J Door Inc
6068	6'-0"	6'-8"	1 1/4"	Wood-Ash	Bi Fold	No	2 sets	None	Oil stain	L B J Door Inc
1956	1'-9"	5'-6"	1/2"	Glass & Metal	Sliding Shower	No	2 sets	None	Frosted glass	L B J Door Inc

WINDOW SCHEDULE

SYMBOL	WIDTH	HEIGHT	MATERIAL	TYPE	SCREEN & STORM	QUANTITY	REMARKS	MANUFACTURER	CATALOG NUMBER
A	3'-8"	3'-0"	Aluminum	Double Hung	Yes	2	4 Lights 4 High	LBJ Window Co	141 PW
B	3'-8"	5'-0"	Aluminum	Double Hung	Yes	1	4 Lights 4 High	LBJ Window Co	145 PW
C	3'-0"	5'-0"	Aluminum	Stationary	STORM ONLY	2	Single Lights	H&J Glass Co	59 PY
D	2'-0"	3'-0"	Aluminum	Double Hung	Yes	1	4 Lights 4 High	LBJ Window Co	142 PW
E	2'-0"	6'-0"	Aluminum	Stationary	STORM ONLY	2	20 Lights	H&J Glass Co	37 TS
F	3'-6"	5'-0"	Aluminum	Double Hung	Yes	1	16 Lights 4 High	LBJ Window Co	141 PW

HEADER SCHEDULE

HEADER SIZE	EXTERIOR		INTERIOR	
	26' & Under	26' to 32'	26' & Under	26' to 32'
2-2x4	3'-6"	3'-0"	Use 2 - 2x6	
2-2x6	6'-6"	6'-0"	4'-0"	3'-0"
2-2x8	8'-6"	8'-0"	5'-6"	5'-0"
2-2x10	11'-0"	10'-0"	7'-0"	6'-6"
2-2x12	13'-6"	12'-0"	8'-6"	8'-0"

SCHEDULES

SHEET 14

BASIC PLAN READING
UNIT IV

ASSIGNMENT SHEET #2 — READ WRITTEN SPECIFICATIONS

NAME ______________________________ SCORE ______________

Both specifications and plans may indicate information about the same items. The symbols and notes appearing on an elevation or plan view, for example, may completely describe a certain aspect of construction. In that event, the written specifications need not repeat the same information. When, however, symbols and notes do not contain complete information, then specifications must include whatever additional information may be required. For example, section and detail views may indicate that subflooring is required. That is not enough information. So, the specifications would have to show the size of the boards to use, the type of boards to use, how the boards are to be mill-finished, and how nailed. Therefore, when you study plans and specifications, you must pay careful attention to what is shown on the plans, as well as to what is set forth in the specifications. A good construction worker cannot possibly obtain a full understanding of all requirements until he or she it thoroughly familiar with both plans and written specifications.

Use the set of written specifications at the end of this assignment sheet to answer the following questions. Do not use abbreviations in your answers.

A. What restriction is applied to the general type of paint that may be used?

____

B. Foundation

1. Under what conditions must concrete piers be installed?

   ____

2. What type of reinforcing is to be used in the foundation? ______________

3. Of what material are the foundation sills to be made?

   ____

4. How is the foundation to be waterproofed?

   ____

5. With what is the soil to be treated to protect against termites? ______________

C. Chimneys and fireplaces

1. What is the size of the fireplace flue? ______________________

2. What type of flue-liner material is to be used? ______________________

3. What material is to be used in the fireplace hearth? ______________________

ASSIGNMENT SHEET #2

4. List additional information given for the fireplace specifications.

____

D. Floors and exterior walls

1. What is the strength of the concrete used in the floor?

____

2. What type of reinforcing is to be used in the floor?

____

E. Miscellaneous

1. What is to be the finish on the concrete of the porch, floor, stoops, and patio?

____

2. With what will the interior walls of the garage be finished?

____

3. Will the driveway be asphalt, gravel, or concrete? _______________

4. What type of material will be used on counter tops?

____

5. What type of wood is specified for the bookcases?

____

6. What type of heating system is specified?

____

7. How many amps should be allowed for the electrical service?

____

8. What make of bathroom fixtures is specified?

____

9. What type and depth of insulation is specified for ceilings?

____

10. Explain if and where any ornamental iron may be used.

____

ASSIGNMENT SHEET #2

FHA Form 2005
VA Form 26-1852
Rev. 2/75

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL HOUSING ADMINISTRATION

For accurate register of carbon copies, form may be separated along above fold. Staple completed sheets together in original order

Form Approved
OMB No. [illegible]

☐ Proposed Construction

DESCRIPTION OF MATERIALS

No. ______ (To be inserted by FHA or VA)

☐ Under Construction

Plan #

Property address ______ City ______ State Oklahoma

Mortgagor or Sponsor ______ (Name) ______ (Address)

Contractor or Builder ______ (Name) ______ (Address)

INSTRUCTIONS

1. For additional information on how this form is to be submitted, number of copies, etc., see the instructions applicable to the FHA Application for Mortgage Insurance or VA Request for Determination of Reasonable Value, as the case may be.

2. Describe all materials and equipment to be used, whether or not shown on the drawings, by marking an X in each appropriate check-box and entering the information called for in each space. If space is inadequate, enter "See misc." and describe under item 27 or on an attached sheet. THE USE OF PAINT CONTAINING MORE THAN ONE HALF OF ONE PERCENT LEAD BY WEIGHT IS PROHIBITED.

3. Work not specifically described or shown will not be considered unless required, then the minimum acceptable will be assumed. Work exceeding minimum requirements cannot be considered unless specifically described.

4. Include no alternates, "or equal" phrases, or contradictory items. (Consideration of a request for acceptance of substitute materials or equipment is not thereby precluded.)

5. Include signatures required at the end of this form.

6. The construction shall be completed in compliance with the related drawings and specifications, as amended during processing. The specifications include this Description of Materials and the applicable Minimum Property Standards.

1. EXCAVATION:

Bearing soil, type Firm clay; Note: Where fill is in excess of 18", concrete piers to be installed at 8' oc and the cost will be added to the contract.

2. FOUNDATIONS:

Footings: concrete mix transite 14"x18" ftg; strength psi 2500 PSI concrete Reinforcing (4) 5/8" steel rebar
Foundation wall: material 2500 PSI concrete Reinforcing ______
Interior foundation wall: material 2500 PSI concrete Party foundation wall 2500 concrete
Columns: material and sizes ______ Piers: material and reinforcing ______
Girders: material and sizes ______ Sills: material west coast utility Douglas fir with sill sealer
Basement entrance areaway ______ Window areaways ______
Waterproofing waterproof mix in concrete Footing drains open mortar joints
Termite protection pretreat soil and stem wall with Chlordane and issue 5 year warranty.
Basementless space: ground cover ______; insulation ______; foundation vents ______
Special foundations thicken slab beam with 2- 5/8" steel rebars to undisturbed soil.
Additional information: see patio details, also porch and fireplace footing.

3. CHIMNEYS:

Material brick Prefabricated (make and size) ______
Flue lining: material terra cotta Heater flue size 6" metalbestos Fireplace flue size 12"x12"
Vents (material and size): gas or oil heater ______; water heater metalbestos
Additional information: ______

4. FIREPLACES:

Type: ☐ solid fuel; ☒ gas-burning; ☐ circulator (make and size) 42" vestal damper Ash dump and clean-out metal
Fireplace: facing brick; lining firebrick; hearth brick; mantel wood
Additional information: note: fireplace stubbed and keyed for gas outlet.

5. EXTERIOR WALLS: 2 x 4 studs @ 16"oc 1/2" plywood at corners.

Wood frame: wood grade, and species w.c. utility d.f. ☒ Corner bracing. Building paper or felt 15# felt
Sheathing flintcoat polyurethane; thickness 3/4"; width 24"; ☒ solid; ☐ spaced ______" o. c.; ☐ diagonal; ______
Siding ______; grade ______; type ______; size ______; exposure ______"; fastening ______
Shingles ______; grade ______; type ______; size ______; exposure ______"; fastening ______
Stucco ______; thickness ______"; Lath ______; weight ______ lb.
Masonry veneer face brick Sills brick Lintels steel supporting brick Base flashing ______
Masonry: ☐ solid ☐ faced ☐ stuccoed; total wall thickness ______"; facing thickness ______"; facing material ______
Backup material ______; thickness ______"; bonding ______
Door sills ______ Window sills ______ Lintels ______ Base flashing ______
Interior surfaces: dampproofing ______ coats of ______; furring ______
Additional information: two coats of exterior paint or stain as selected by owner.
Exterior painting: material ______; number of coats ______
Gable wall construction: ☐ same as main walls; ☒ other construction cedar plywood or vertical siding as shown on elevations.

FHA Form 2005
VA Form 26-1852

DESCRIPTION OF MATERIALS

BEST COPY AVAILABLE

ASSIGNMENT SHEET #2

DESCRIPTION OF MATERIALS

6. FLOOR FRAMING:

Joists: wood, grade, and species ______, other ______, bridging ______, anchors 1/2"x8"

Concrete slab ☐ basement floor, ☐ first floor, ☒ ground supported, ☐ self-supporting, mix 3500 PSI concrete, thickness 4"

reinforcing 6x6-W1.4xW1.4 WWF, insulation 1" perimeter, membrane waterproof concrete

Fill under slab: material sand fill, thickness 4", Additional information ______

7. SUBFLOORING: *(Describe underflooring for special floors under item 21.)*

Material: grade and species 3/4" AC exterior plywood, size ______, type ______

Laid: ☐ first floor, ☐ second floor, ☒ attic 200 sq. ft sq. ft., ☐ diagonal, ☐ right angles. Additional information ______

8. FINISH FLOORING: *(Wood only. Describe other finish flooring under item 21.)*

Location	Rooms	Grade	Species	Thickness	Width	Bldg. Paper	Finish
First floor	living area, formal dining,						
Second floor	hall and bedrooms: pad and carpet installed;						allowance per square foot
Attic floor	sq. ft.						

Additional information ______

9. PARTITION FRAMING:

Studs: wood, grade, and species w.c. utility d.f. size and spacing 2x4 studs @16"oc Other ______

Additional information NOTE: 2 x 6 studs where needed for plumbing vents.

10. CEILING FRAMING:

Joists: wood, grade, and species w.c. standard d.f. Other see floor plan Bridging 2x4 flat and 2x6 up midspan stiffener

Additional information see typical sheet for construction details.

11. ROOF FRAMING:

Rafters: wood, grade, and species w.c. utility d.f. Roof trusses (see detail): grade and species ______

Additional information 2x6 rafters @24"oc, unless spans exceed allowable.

12. ROOFING:

Sheathing: wood, grade, and species west coast utility Douglas fir; ☐ solid; ☒ spaced ______" o.c.

Roofing 240 #3 tab sq. butt asphalt shingles; grade #1; size ______; type ______

Underlay ______; weight or thickness 5/2; size 16"; fastening nail

Built-up roofing ______; number of plies ______; surfacing material ______

Flashing: material galvanized iron; gage or weight 26 gauge; ☐ gravel stops; ☐ snow guards

Additional information ______

13. GUTTERS AND DOWNSPOUTS: Gutter over entryway

Gutters: material galvanized iron; gage or weight 26 gauge; size 5"; shape o-gee

Downspouts: material galvanized iron; gage or weight 26 gauge; size 3"x4"; shape square; number as need

Downspouts connected to: ☐ Storm sewer; ☐ sanitary sewer; ☐ dry-well. ☒ Splash blocks: material and size ______

Additional information ______

14. LATH AND PLASTER

Lath ☐ walls, ☐ ceilings: material ______; weight or thickness ______ Plaster: coats ______; finish ______

Dry-wall ☒ walls, ☒ ceilings: material Sheetrock; thickness 1/2"; finish medium texture

Joint treatment mud and tape; NOTE: Sheetrock applied according to manufacturer's specs.

15. DECORATING: *(Paint, wallpaper, etc.)*

Rooms	Wall Finish Material and Application	Ceiling Finish Material and Application
Kitchen		
Bath ALL ROOMS:	paint and/or wallpaper	all ceilings to be textured
Other		and painted two coats flat paint.
	WALLPAPER ALLOWANCE: $	(includes cost of labor)

Additional information PANELING: 1/4" v-groove ash

16. INTERIOR DOORS AND TRIM:

Doors: type hollow core slab; material ash or birch; thickness 1-3/8"

Door trim: type detail; material white pine. Base: type detail; material white pine; size 3-1/4"

Finish: doors hand-rubbed stain; trim hand-rubbed stain

Other trim *(item, type and location)* Note: All headers to meet schedule as shown on detail sheet.

Additional information ______

17. WINDOWS: ALL THERMOPANE GLASS- fixed and operating.

Windows: type single hung; make Alenco or equal; material aluminum; sash thickness 1"

Glass: grade DSB; ☐ sash weights; ☒ balances, type spring; head flashing galvanized

Trim: type Sheetrock return; material Sheetrock Paint texture & paint; number coats 2

Weatherstripping: type with units; material wool pile Storm sash, number ______

Screens: ☒ full; ☐ half; type metal or aluminum; number all; screen cloth material 16" aluminum mesh

Basement windows: type ______; material ______; screens, number ______; Storm sash, number ______

Special windows See plans for fixed windows

Additional information NOTE: Sheetrock return on all windows with wood stool and apron.

FOC-347-B

ASSIGNMENT SHEET #2

DESCRIPTION OF MATERIALS

18. ENTRANCES AND EXTERIOR DETAIL:

Main entrance door: material ash panel width see plans thickness 1-3/4" Frame: material w. pine thickness 1-1/8"
Other entrance doors: material w.p. m.c. width plans thickness 1-3/4" Frame: material w. pine thickness 1-1/8"
Head flashing galvanized iron Weatherstripping: type spring bronze Thresholds: aluminum
Screen doors: thickness ___ number ___ screen cloth material ___ Storm doors: thickness ___ number ___
Combination storm and screen doors: thickness ___ number ___ screen cloth material ___
Shutters: ☐ hinged; ☐ fixed. Railings ___, Attic louvers galvanized back screen in soffit
Exterior millwork: grade and species redwood or rough cedar Paint exterior paint or stain number coats 2
Additional information: Thermopane glass sliding doors with alum. frame

19. CABINETS AND INTERIOR DETAIL:

Kitchen cabinets, wall units: material ash with white pine stiles lineal feet of shelves ___ shelf width 12"
Base units: material ash with white pine counter top Formica edging self-edge Formica
Back and end splash full Formica Finish of cabinets enamel or hand-rubbed stain number coats 5
Medicine cabinets: make ___ model ___
Other cabinets and built-in furniture Ash raised panel door and drawer fronts--shop built
Additional information built-in vanities with synthetic marble or Formica top and splash; built-in ash bookcases (See plans)

20. STAIRS:

Stair	Treads		Risers		Strings		Handrail		Balusters	
	Material	Thickness	Material	Thickness	Material	Size	Material	Size	Material	Size
Basement										
Main										
Attic										

Disappearing: make and model number pull-down ladder to attic access in garage.2040
Additional information:

21. SPECIAL FLOORS AND WAINSCOT:

	Location	Material, Color, Border, Sizes, Gage, Etc.	Threshold Material	Wall Base Material	Underfloor Material
Floors	Kitchen	utility: sheet vinyl			
	Baths	ceramic tile	ceramic	white pine	concrete
	Main entry	earthstone	aluminum	white pine	concrete
	Rear entry	sheet vinyl	aluminum		concrete

	Location	Material, Color, Border, Cap, Sizes, Gage, Etc.	Height	Height Over Tub	Height in Showers (From Floor)
Wainscot	Bath	(tub & shower ceramic tile over metl lath and grout area only)		72"	72"
	remainder of				
	bath walls: 1/4 " v-groove ash wainscoting 32 " high				

Bathroom accessories: ☐ Recessed; material brushed chrome, number ___; ☐ Attached; material brushed chrome, number ___
Additional information:

22. PLUMBING:

Fixture	Number	Location	Make	Mfr's Fixture Identification No.	Size	Color
Sink	1	kitchen	Kohler	Delafield k-5950	32"x21"	color
Lavatory		baths	Kohler	Caxton k-2210	19"x15"	color
Water closet		baths	Kohler	Wellsworth k-3500 eb	reverse trap	color
Bathtub		bath	Kohler	Villager k-715	60"	color
Shower over tub△		bath	Kohler	chrome divertor over tub		
Stall shower△		bath	ceramic stall shower with glass door (job built)			
Laundry trays						
optional:	1	Kohler party bar sink with single lever faucet in utility rm.				
	NOTE: Kohler faucets on all lavatories and sinks.					

△☒ Curtain rod △☒ Door ☐ Shower pan: material ___
Water supply: ☒ public; ☐ community system; ☐ individual (private) system.★
Sewage disposal: ☒ public; ☐ community system; ☐ individual (private) system.★
★Show and describe individual system in complete detail in separate drawings and specifications according to requirements.
House drain (inside): ☐ cast iron; ☐ tile; ☒ other ABS or PVC House sewer (outside): ☐ cast iron; ☒ tile; ☐ other 4" ABS
Water piping: ☐ galvanized steel; ☒ copper tubing; ☐ other type L hard-drawn joints, Sill cocks, number frostproof
Domestic water heater: type automatic ; make and model Rheem or State ; heating capacity 40 gallons
25.2 gph. 100° rise. Storage tank: material glass lined ; capacity 40 gallons.
Gas service: ☒ utility company; ☐ liq. pet. gas; ☐ other ___ Gas piping: ☐ cooking; ☒ house heating.
Footing drains connected to: ☐ storm sewer; ☐ sanitary sewer; ☐ dry well. Sump pump; make and model ___
___ ; capacity ___ ; discharges into ___

ASSIGNMENT SHEET #2

DESCRIPTION OF MATERIALS

23. HEATING:

☐ Hot water ☐ Steam ☐ Vapor ☐ One-pipe system ☐ Two-pipe system

☐ Radiators ☐ Convectors ☐ Baseboard radiation Make and model

Radiant panel ☐ floor, ☐ wall, ☐ ceiling Panel coil material

☐ Circulator ☐ Return pump Make and model capacity gpm

Boiler: make and model Output Btuh., net rating Btuh.

Additional information

Warm air ☐ Gravity ☒ Forced Type of system perimeter under floor

Duct material: supply concrete ; return sheet metal Insulation fiberglas thickness 1" ☐ Outside air intake

Furnace: make and model See heating and air conditioning Input 120,000 Btuh.; output 96,000 Btuh.

Additional information: Layout; to be prepared by mechanical contractor.

☐ Space heater; ☐ floor furnace; ☐ wall heater Input Btuh.; output Btuh.; number units

Make, model Additional information

Controls: make and types

Additional information

Fuel: ☐ Coal; ☐ oil; ☐ gas; ☐ liq. pet. gas; ☐ electric; ☐ other ; storage capacity

Additional information:

Firing equipment furnished separately: ☐ Gas burner, conversion type. ☐ Stoker: hopper feed ☐; bin feed ☐

Oil burner: ☐ pressure atomizing; ☐ vaporizing

Make and model Control furnace.

Additional information: NOTE: Gas outlet for hot water tank, furnace and fireplace jet, and garage

Electric heating system: type Input watts; @ volts; output Btuh.

Additional information:

Ventilating equipment: attic fan, make and model capacity 1,800 cfm.

kitchen exhaust fan, make and model kitchen vent hood and exhaust fan.

Other heating, ventilating, or cooling equipment Nutone or equal ceiling heaters in baths.

24. ELECTRIC WIRING: allow for 200 amp service

Service: ☐ overhead; ☐ underground. Panel: ☐ fuse box; ☒ circuit-breaker; make square D AMP's as required No. circuits

Wiring: ☐ conduit; ☒ armored cable; ☐ nonmetallic cable; ☐ knob and tube; ☐ other romex wiring if code allows

Special outlets: ☒ range; ☐ water heater; ☐ other 220 volt for oven, range, dryer, and air conditioning

☐ Doorbell. ☒ Chimes. Push-button locations Additional information:

25. LIGHTING FIXTURES:

Total number of fixtures see plans Total allowance for fixtures, typical installation, $

Nontypical installation

Additional information: Optional Fluorescent grid, dropped ceiling in kitchen as shown on plans

26. INSULATION:

Location	Thickness	Material, Type, and Method of Installation	Vapor Barrier
Roof			
Ceiling	12"	loose-fill fiberglass insulation in ceiling of house only	(blown between jsts)
Wall	4"	batts- fiberglass insulation- exterior walls of house	(stapled to studs)
Floor	1"	perimeter insulation under slab.	

27. MISCELLANEOUS: *(Describe any main dwelling materials, equipment, or construction items not shown elsewhere; or use to provide additional information where the space provided was inadequate. Always reference by item number to correspond to numbering used on this form.)*

LIGHTING FIXTURES. . . . . . . $ as per contract

WALLPAPER. . . . . $ per contract labor and material

LANDSCAPING. . . . . $ as per contract

CARPET ALLOWANCE. . . . . . . $ PER SQUARE YARD INSTALLED as per contract

Cabinet over washer and dryer.

Waterproof outlet on patio.

Ornamental fence and gate at main entrance

HARDWARE: *(make, material, and finish.)*

Dexter or equal passage sets and locks- all exterior doors keyed alike

deadbolt locks on all exterior doors.

ASSIGNMENT SHEET #2

DESCRIPTION OF MATERIALS

SPECIAL EQUIPMENT: *(State material or make, model and quantity. Include only equipment and appliances which are acceptable by local law, custom and applicable FHA standards. Do not include items which, by established custom, are supplied by occupant and removed when he vacates premises or chattles prohibited by law from becoming realty.)*

APPLIANCE ALLOWANCE: $
AS SELECTED BY OWNER WITHIN SPECIFIED ALLOWANCE

PORCHES:

foundation construction: 6" x 8" poured monolithic with the slab.
floor: 4" concrete slab with 6x6-W1.4xW1.4 WWF smooth trowel finish.

TERRACES:

stoops: 4" concrete slab- smooth trowel finish.
patio: 4" concrete slab- smooth trowel finish. - see plans for size.

GARAGES: automatic garage door opener
foundation: 14" x 18" concrete footing with (4) 5/8" rebars; 6" concrete stem wall
floor: 4" concrete with 6x6-W1.4xW1.4 WWF; smooth trowel finish floors.
interior: 3/8" prefinished Sheetrock on walls; texture and paint 1/2" Sheetrock on ceiling

WALKS AND DRIVEWAYS:

Driveway: width see plot base material tamped earth ; thickness 4 "; surfacing material concrete ; thickness 4 "
Front walk: width 36" ; material concrete; thickness 4 ". Service walk: width ____ ; material ____ ; thickness ____ "
Steps: material ____ ; treads ____ "; risers ____ ". Cheek walls ____

OTHER ONSITE IMPROVEMENTS:

(Specify all exterior onsite improvements not described elsewhere, including items such as unusual grading, drainage structures, retaining walls, fence, railings, and accessory structures.)

NOTE: All dimensions to be rechecked on site prior to beginning construction by builder and builder shall be responsible for the same.

LANDSCAPING, PLANTING, AND FINISH GRADING:

Topsoil ____ " thick: ☐ front yard; ☐ side yards; ☐ rear yard to ____ feet behind main building.
Lawns *(seeded, sodded, or sprigged)*: ☐ front yard ____ ; ☐ side yards ____ ; ☐ rear yard ____
Planting: ☐ as specified and shown on drawings; ☐ as follows:

____ Shade trees, deciduous, ____ " caliper.		____ Evergreen trees.	____ ' to ____ ', B & B
____ Low flowering trees, deciduous,	____ ' to ____ '	____ Evergreen shrubs.	____ ' to ____ ', B & B
____ High-growing shrubs, deciduous,	____ ' to ____ '	____ Vines, 2-year	____
____ Medium-growing shrubs, deciduous,	____ ' to ____ '		
____ Low-growing shrubs, deciduous,	____ ' to ____ '		

IDENTIFICATION.—This exhibit shall be identified by the signature of the builder, or sponsor, and/or the proposed mortgagor if the latter is known at the time of application.

Date ____ Signature ____

Signature ____

FHA Form 2005
VA Form 26-1852

BASIC PLAN READING
UNIT IV

ASSIGNMENT SHEET #3 — READ AN ARCHITECT'S SCALE

NAME ______________________________ SCORE ______________

Construction workers need to be skilled in using an architect's scale. Learning to read an architect's scale proficiently also aids in reading plans.

Use an architect's scale to complete this assignment sheet. Keep in mind the following guidelines.

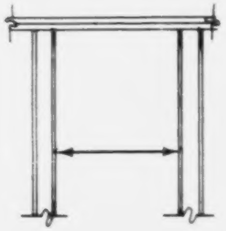
- Select proper scale ratio.
- Be sure that scale is lying flat on surface being measured.
- Double-check all measurements.
- Practice measuring from center of one line to center of next line.
- Do not use scale if dimensions are available.

(NOTE: Accuracy may vary because of distortion due to the plan reproduction process.)

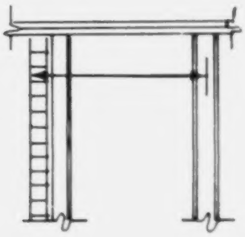
PART I

Use the architect's scale to find the following dimensions. Write your answers in the blanks.

______________A. Scale to 1/16" = 1'-0"

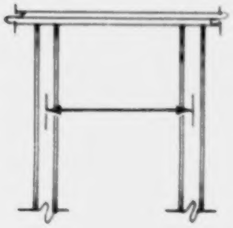


______________B. Scale to 1/8" = 1'-0"

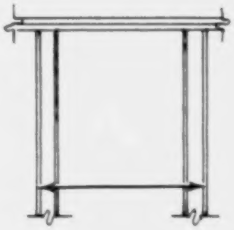


ASSIGNMENT SHEET #3

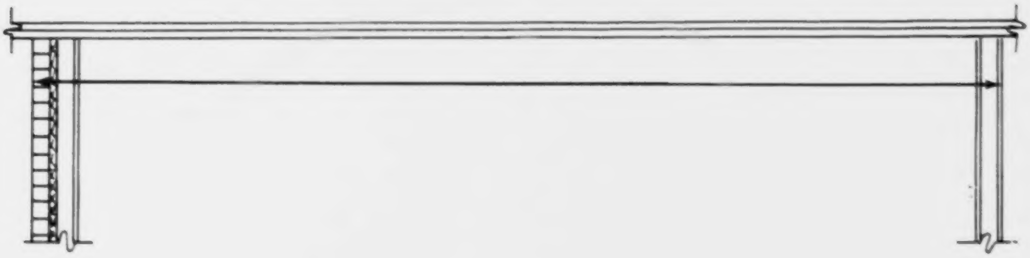
____________________C. Scale to ¼" = 1'-0"



____________________D. Scale to ½" = 1'-0"



____________________E. Scale to 1½" = 1'-0"

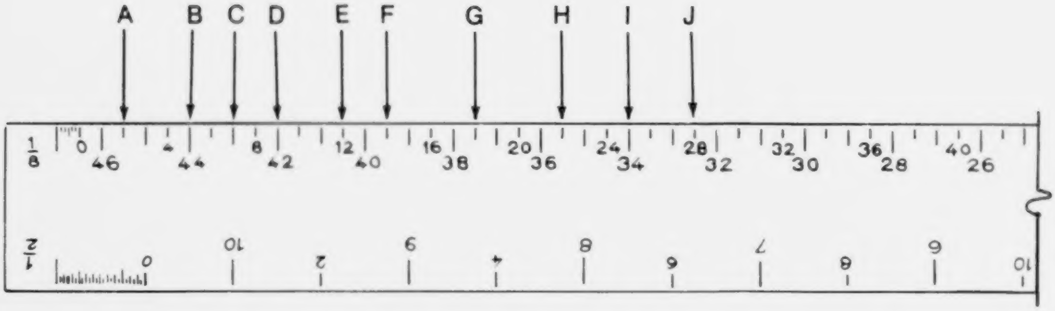


PART II

Read the following scales from zero to the letter points indicated. Write the correct readings in the blanks below the scales.

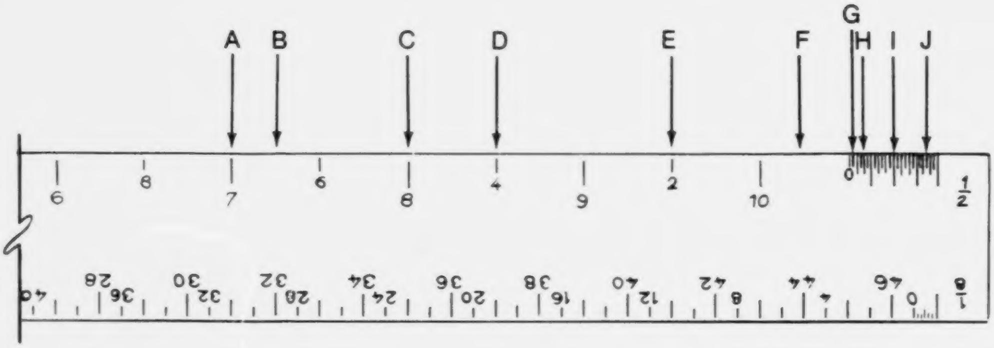
ASSIGNMENT SHEET #3

A.


A
B
C
D
E
F
G
H
I
J
1/8
1/2

1. A = ______________________
2. B = ______________________
3. C = ______________________
4. D = ______________________
5. E = ______________________
6. F = ______________________
7. G = ______________________
8. H = ______________________
9. I = ______________________
10. J = ______________________

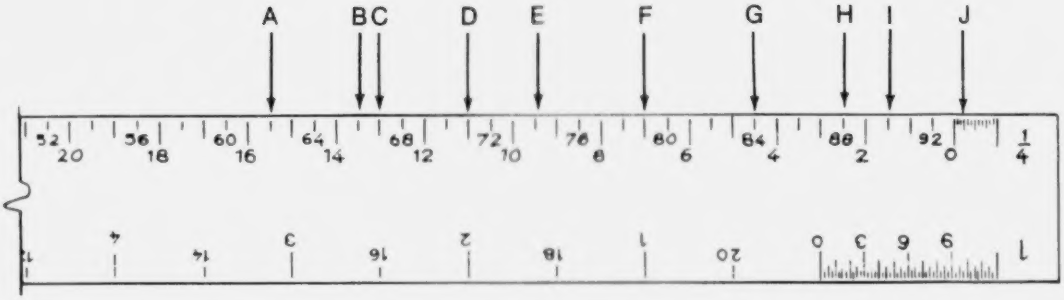
B.


A
B
C
D
E
F
G
H
I
J
1/2
1/8

1. A = ______________________
2. B = ______________________
3. C = ______________________
4. D = ______________________
5. E = ______________________
6. F = ______________________
7. G = ______________________
8. H = ______________________
9. I = ______________________
10. J = ______________________

ASSIGNMENT SHEET #3

C.


A
B
C
D
E
F
G
H
I
J
52
56
60
64
68
72
76
80
84
88
92
20
18
16
14
12
10
8
6
4
2
0
1/4
4
14
3
16
2
18
1
20
0
3
6
9
9
1

1. A = ____________________

2. B = ____________________

3. C = ____________________

4. D = ____________________

5. E = ____________________

6. F = ____________________

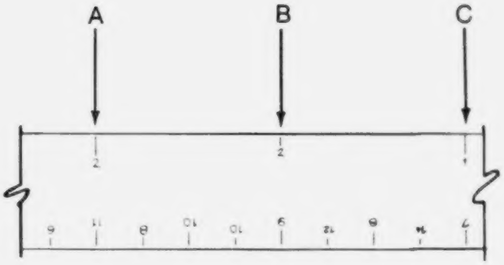
7. G = ____________________

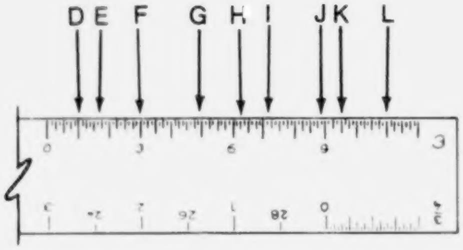
8. H = ____________________

9. I = ____________________

10. J = ____________________

D.




D
E
F
G
H
I
J
K
L
0
3
6
9
3

(NOTE: This illustration has been reduced).

1. A = ____________________

2. B = ____________________

3. C = ____________________

4. D = ____________________

5. E = ____________________

6. F = ____________________

7. G = ____________________

8. H = ____________________

9. I = ____________________

10. J = ____________________

11. K = ____________________

12. L = ____________________

BASIC PLAN READING
UNIT IV

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. 1. 51'-9" × 57'-0"
2. 296'-4"
3. 16'-0" × 49'-0"
4. West
5. 40'-0"
6. 3'-0"
7. 47'-6"
8. 27'-6"
9. 300'-10"
10. 1" = 20'-0"

B. 1. 4"
2. W1.4 × W1.4 welded wire fabric
3. 14"
4. 6"
5. 3/4"
6. 3500#
7. Four
8. 3/4"
9. 1/2" × 8"
10. 2"
11. Rigid
12. 7D
13. 12"
14. 7C and 7D
15. Sand

C. 1. 11'-4 1/4" × 13'-7 1/2"
2. 12 1/4"
3. Expansion joint
4. 13'-6 1/4
5. 1/2 inch
6. Approx. 1900 square feet
7. 3/4"
8. 8 1/2"
9. 5'-9 1/4" × 9'-3"
10. 14'-8" × 28'-0"
11. 2'-0" × 4'-2" × 2'-2 1/2"
12. 4'
13. Brick
14. 4"

D. 1. Six
2. S_3or three-way switches
3. Special purpose for clothes dryer
4. S or single-pole switch
5. Four or three and a phone jack
6. Surface incandescent, ceiling
7. Surface incandescent, wall
8. Yes, one on patio
9. In closet of bedroom #3
10. Four or three and a phone jack

E. 1. One
2. Ceiling at south end of hallway
3. Sixteen inch
4. Twelve
5. Six inche
6. Three
7. Living room
8. Outside south wall of building
9. Twelve inch
10. Twelve

F. 1. Front lawn, west of building
2. Two
3. East
4. Four inch
5. Gas
6. Four
7. Two
8. Three-quarter inch
9. Bedroom #2
10. Clean-out

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #2

A. May not contain more than five-tenths of one-percent lead by weight

B. 1. Where fill is in excess of 18"
   2. 5/8" steel rebar
   3. West coast utility Douglas fir
   4. Sill sealer and waterproof mixture in concrete
   5. Chlordane

C. 1. 12" x 12"
   2. Terra cotta
   3. Brick
   4. Fireplace is to be stubbed and keyed for gas outlet

D. 1. 3500# or 3500 psi
   2. 6 x 6-W1.4 x W1.4 WWF

E. 1. Smooth trowel finish
   2. 3/8" prefinished Sheetrock
   3. Concrete
   4. Formica
   5. Ash
   6. Perimeter under floor
   7. 200 amp
   8. Kohler
   9. Loose-fill fiberglass, 12 inches
   10. Ornamental fence and gate is specified at the main entrance

Assignment Sheet #3

Part I

(NOTE: Answers may vary slightly due to printing distortions.)

A. 11'-3"
B. 8'-1"
C. 3'-4"
D. 1'-11"
E. 3'-8"

Part II

A. 1. 2'-0"
   2. 5'-0"
   3. 7'-0"
   4. 9'-0"
   5. 12'-0"
   6. 14'-0"
   7. 18'-0"
   8. 22'-0"
   9. 25'-0"
   10. 28'-0"

B. 1. 7'-0"
   2. 6'-6"
   3. 5'-0"
   4. 4'-0"
   5. 2'-0"
   6. 6"
   7. 1/2"
   8. 2"
   9. 6"
   10. 10 1/2"

C. 1. 15'-6"
   2. 13'-6"
   3. 13'-0"
   4. 11'-0"
   5. 9'-6"
   6. 7'-0"
   7. 4'-6"
   8. 2'-6"
   9. 1'-6"
   10. 3"

D. 1. 2'-0"
   2. 1'-0"
   3. 1'-0"
   4. 1"
   5. 1 5/8"
   6. 3"
   7. 4 7/8"
   8. 6 1/4"
   9. 7 1/8"
   10. 8 7/8"
   11. 9 1/2"
   12. 11"

BASIC PLAN READING
UNIT IV

TEST

NAME ______________________________ SCORE ______________

1. Match the following terms associated with plan reading to their correct definitions. Write the correct numbers in the blanks. Terms and definitions are continued on the next page.

_____a. Lines used on plot plans and topographical surveys to show both natural grade and finish grade elevations

_____b. Reproductions of architect's drawings; also called *plans* or *construction plans*

_____c. Drawing of natural and man-made features of a place or region showing their relative positions and elevations

_____d. Exact measured size of a unit

_____e. 1) Given grade; 2) outside view of a structure

_____f. Drawing by a structural engineer; may accompany architect's plans and give important information about foundation, skeleton, and floor system

_____g. Set of detailed working drawings or plans drawn to scale by an architect, showing all information and dimensions necessary to build or remodel a structure; original drawings from which blueprints are made

_____h. Drawing made to a size either proportionally larger or smaller than the actual size of the object represented

_____i. Drawing having many of the features of a photograph; drawn by the architect to interest buyers

_____j. Drawing showing location and details about plumbing and electrical components and heating and air-conditioning units

_____k. Approximate or rough size of a unit

_____l. Point of known or assumed elevation used by surveyor as a reference point in determining other elevations

_____m. Detailed set of written instructions that supplements the set of plans, describes equipment and materials used in the structure, and becomes a part of the contract

1. Benchmark
2. Blueprints
3. Perspective drawing
4. Elevation
5. Mechanical drawing
6. Architect's drawings
7. Nominal dimension
8. Actual dimension
9. Structural drawing
10. Scale drawing
11. Contour lines
12. Topographical survey
13. Specifications

TEST

______n. Listing or chart of parts (keyed to the plans), amounts, materials or products, and details

______o. Using conventional dimension lines and figures to indicate actual sizes and distances of objects and spaces represented

______p. Architect's standard method of representing dimensions and structural details

______q. Three-sided rule with six ruled faces designed to measure in twelve different scales of proportional feet and inches

______r. Important aspect of plan reading that involves looking at and thinking about a structural detail, or a symbol for such a detail, and being able to form a mental picture of how such a detail is constructed or assembled

14. Architect's scale
15. Convention
16. Dimensioning
17. Visualization
18. Finish schedule

2. Match to their correct descriptions types of drawings usually included in a set of plans. Write the correct numbers in the blanks.

______a. Horizontal view of building, showing length and breadth of building and layout of rooms on that floor

______b. Horizontal view showing where building is to be located on site

______c. Cut-away vertical view through an object or wall to show its interior makeup

______d. Vertical, two-dimensional view of each of the exterior faces of a building, showing general shape and design of exterior and roof

______e. Graphic, at a larger scale, of part of another drawing, indicating special features of design, location, and composition and the correlation of the elements and materials shown

______f. Horizontal view of entire masonry substructure below first floor or frame of building

______g. Floor plan with heating, ventilating, and air conditioning symbols showing location and type of equipment, movement of hot and cold air, and location and size of ducts and diffusers

______h. Floor plan with symbols representing location and type of fixtures, vents, valves, and pipe that will be installed in the structure

______i. Floor plan with electrical symbols showing exact location of switches, outlets, and electrical devices to accommodate appliances and fixtures; also lines that represent wiring from each switch to the connecting fixtures

1. Plot plan
2. Foundation plan
3. Floor plan
4. Elevation
5. Section
6. Detail
7. Plumbing floor plan
8. Electrical floor plan
9. Heating, ventilating, and air conditioning floor (HVAC) plan

TEST

3. List information found on types of drawings in a set of plans.

a. Plot plan (List four.)

1) ____________________
2) ____________________
3) ____________________
4) ____________________

b. Foundation plan (List two.)

1) ____________________
2) ____________________

c. Floor plan (List five.)

1) ____________________
2) ____________________
3) ____________________
4) ____________________
5) ____________________

d. Elevation (List four.)

1) ____________________
2) ____________________
3) ____________________
4) ____________________

e. Section (List three.)

1) ____________________
2) ____________________
3) ____________________

f. Detail (List six.)

1) ____________________
2) ____________________

BEST COPY AVAILABLE

TEST

3) ______________________________

4) ______________________________

5) ______________________________

6) ______________________________

4. Match lines in the alphabet of lines to their correct uses. Write the correct numbers in the blanks.

______a. Used to connect a note or dimension to a related part of the drawing

______b. Used to show main outline of structure, including exterior walls, interior partitions, porches, patios, sidewalks, parking lots, and driveways

______c. Used as parameters for dimension lines

______d. Used to designate object and area dimensions

______e. Used to indicate alternate positions of moving parts, adjacent positions of related parts, and for repeated details

______f. Used to indicate an area that has been cut away and shown in a section view; arrows indicate direction from which section drawing is to be viewed

______g. Used to show lines that are not visible from view depicted

______h. Used to show that an object or area has not been drawn in its entirety

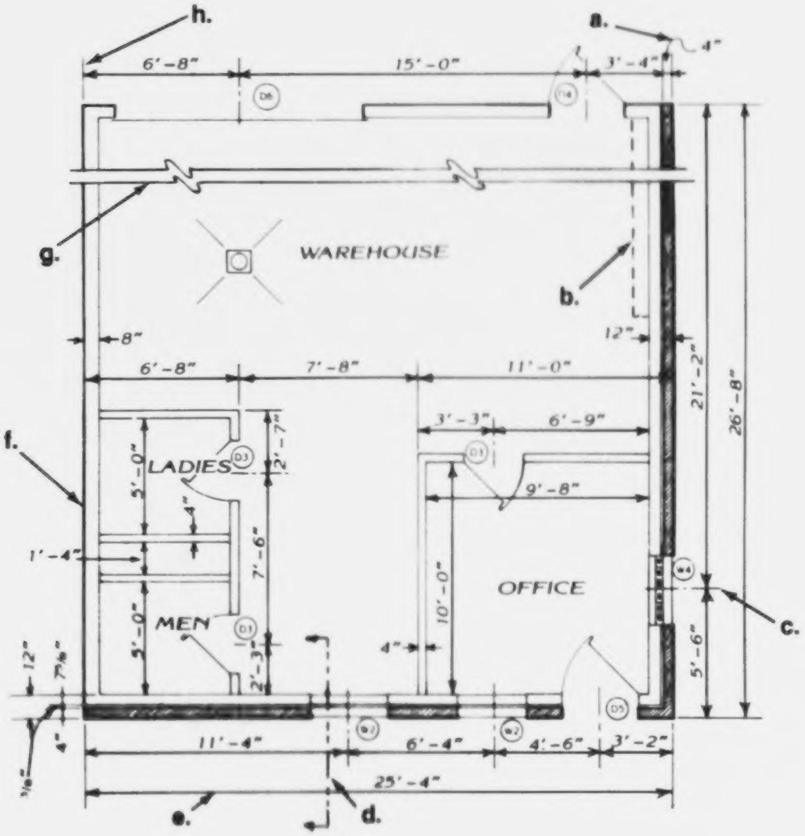
______i. Used to designate center and to provide a reference point for dimensioning

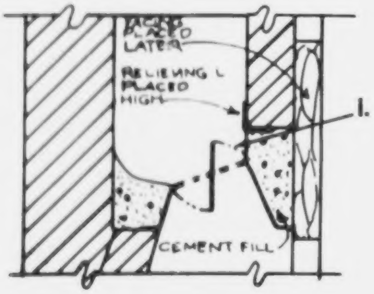
1. Break line
2. Center line
3. Cutting plane line (section line)
4. Dimension line
5. Extension lines
6. Hidden line
7. Leader line
8. Object line
9. Phantom line

TEST

5. Identify lines in the alphabet of lines. Write the correct letters in the blanks.

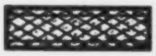
______**Object line**
______**Dimension line**
______**Extension line**
______**Hidden line**
______**Center line**
______**Cutting plan (section line)**
______**Break line**
______**Phantom line**
______**Leader line**

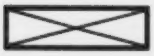

h.
a.
4"
6'-8"
15'-0"
3'-4"
WAREHOUSE
g.
b.
8"
12"
6'-8"
7'-8"
11'-0"
21'-2"
26'-8"
f.
LADIES
MEN
3'-3"
6'-9"
9'-8"
5'-0"
4"
2'-7"
7'-6"
1'-4"
5'-0"
2'-3"
10'-0"
4"
OFFICE
c.
5'-6"
12"
7½"
4"
11'-4"
6'-4"
4'-6"
3'-2"
25'-4"
e.
d.

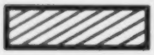

FACING PLACED LATER
RELIEVING L PLACED HIGH
i.
CEMENT FILL

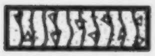
TEST

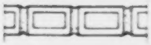
6. Identify the following selected architectural symbols commonly used to represent materials on plans. Write the correct names in the blanks.

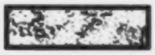

a. ______________________________

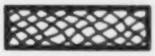

b. ______________________________

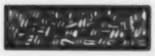

c. ______________________________

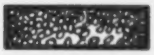

d. ______________________________

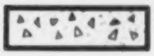

e. ______________________________

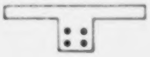

f. ______________________________

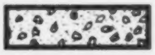

g. ______________________________

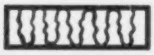

h. ______________________________

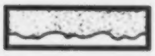

i. ______________________________

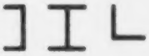

j. ______________________________

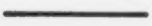

k. ______________________________


l. ______________________________


m. ______________________________


n. ______________________________

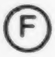

o. ______________________________


p. ______________________________

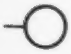
TEST

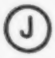
7. Identify the following electrical symbols used on plans. Write the correct names in the blanks.

a. Lighting outlets

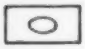


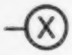
1. ____________________


2. ____________________

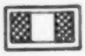


3. ____________________

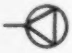

4. ____________________

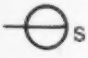


5. ____________________

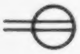

6. ____________________

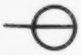
b. Receptacle outlets

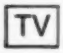

1. ____________________



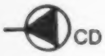
2. ____________________


3. ____________________


4. ____________________



5. ____________________



6. ____________________

c. Switch outlets

$\underline{S}$ 1. ____________________

S_P 2. ____________________

S_2 3. ____________________

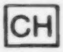
S_D 4. ____________________

S_{WP} 5. ____________________

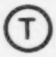
S 6. ____________________

TEST

d. Auxiliary systems

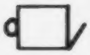


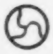
1. ______________________________

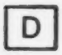


2. ______________________________

3. ______________________________

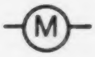

4. ______________________________


5. ______________________________

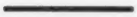


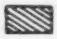
6. ______________________________

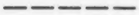
e. Panels and miscellaneous



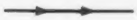
1. ______________________________


2. ______________________________


3. ______________________________

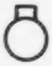

4. ______________________________

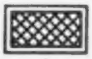
5. ______________________________

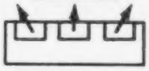

6. ______________________________

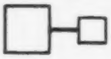
8. Identify the following HVAC symbols used on plans. Write the correct names in the blanks.

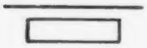
a. Heating and ventilating


1. ______________________________

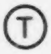

2. ______________________________

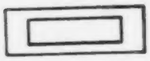

3. ______________________________

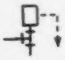

4. ______________________________

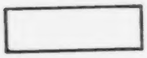

5. ______________________________

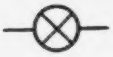
TEST


6. ____________________

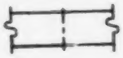

7. ____________________

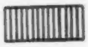

8. ____________________

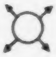

9. ____________________

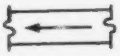

10. ____________________

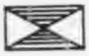
b. Ductwork

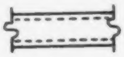

1. ____________________

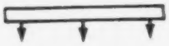

2. ____________________

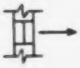

3. ____________________


4. ____________________


5. ____________________


6. ____________________


7. ____________________


8. ____________________

c. Heating pipes

—— FOR —— 1. ____________________

—— HG —— 2. ____________________

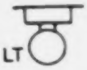
—— HWR —— 3. ____________________

— G — G — 4. ____________________

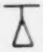
TEST

9. Identify the following plumbing symbols used on plans. Write the correct names in the blanks.

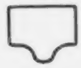
a. Fixtures



1. ______________________________

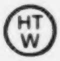


2. ______________________________

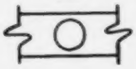


3. ______________________________

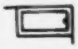
4. ______________________________



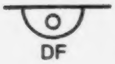
5. ______________________________



6. ______________________________

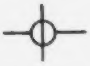


7. ______________________________

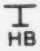


8. ______________________________

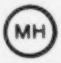
b. Accessories



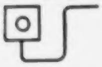
1. ______________________________



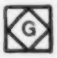
2. ______________________________



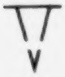
3. ______________________________



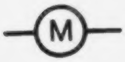
4. ______________________________



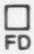
5. ______________________________



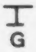
6. ______________________________



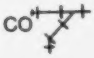
7. ______________________________



8. ______________________________



9. ______________________________



10. ______________________________

TEST

c. Lines

—— CWV —— 1. ____________________

——G——G—— 2. ____________________

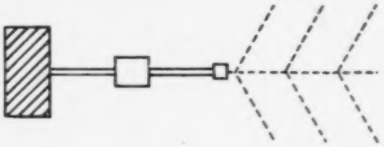
- - - - - - - - - - 3. ____________________

S-CI 4. ____________________

———————— 5. ____________________

—— — —— — —— 6. ____________________

d. ____________________



10. Identify the following selected electrical symbols commonly used on plans. Write the correct names in the blanks.

____________________ a. 16"CC

____________________ b. 3′-6"MOPNG

____________________ c. CONC B WALL

____________________ d. EQUAL FROM CL

____________________ e. EXC 4" deeper

____________________ f. TYP

____________________ g. 6" × 8" BM

____________________ h. DET NTS

____________________ i. 14 Rs

____________________ j. REINF CONC APRON

____________________ k. LINTEL ∠ IRON

____________________ l. WH 48" OC

TEST

__________________________ m. SEE SPEC

__________________________ n. STR STL

__________________________ o. BM 114′

__________________________ p. KWH

__________________________ q. PUT IN 6 CIRBKR

__________________________ r. Hook hose to HB

__________________________ s. OI Gate

__________________________ t. WC

__________________________ u. ¾"CW

__________________________ v. Use 14" × 20D

__________________________ w. 50 gal WH

__________________________ x. Need 4 duplex RECP

__________________________ y. Use a SAN P-trap

__________________________ z. Order batt INS

11. Match the following architect's conventions to their correct representations. Write the correct numbers in the blanks. Representations are continued on the next page.

______a. Doors and windows in brick veneer and wood stud walls

______b. Doors and windows in concrete wall

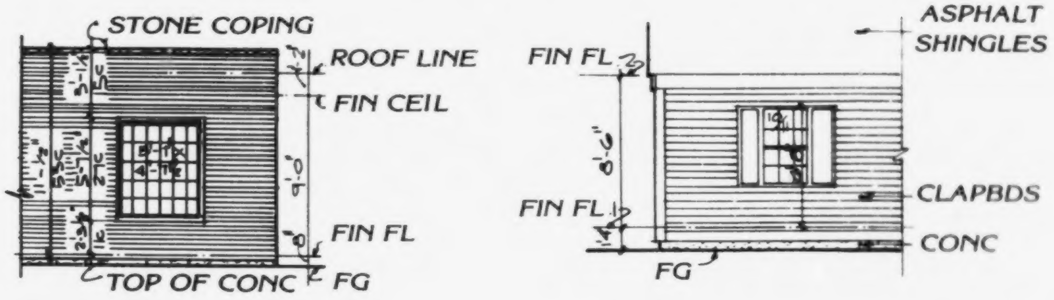
______c. Dimensioning exterior and interior walls

______d. Doors and windows in solid brick wall

______e. Window elevations

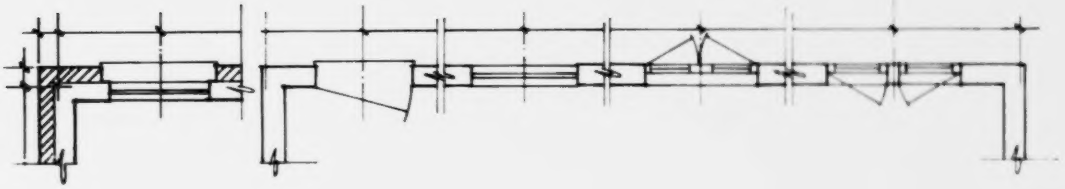
______f. Interior dimensions and alterations

1)

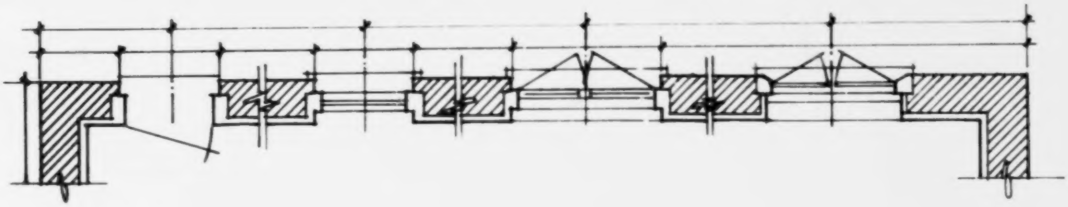

STONE COPING
ROOF LINE
FIN CEIL
9'-0"
FIN FL
TOP OF CONC
FG
ASPHALT SHINGLES
FIN FL
8'-0"
FIN FL
CLAPBDS
CONC
FG

TEST

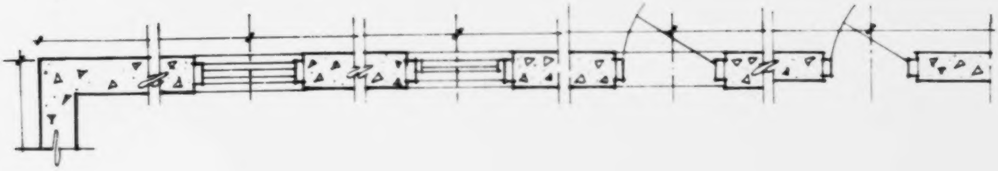
2)



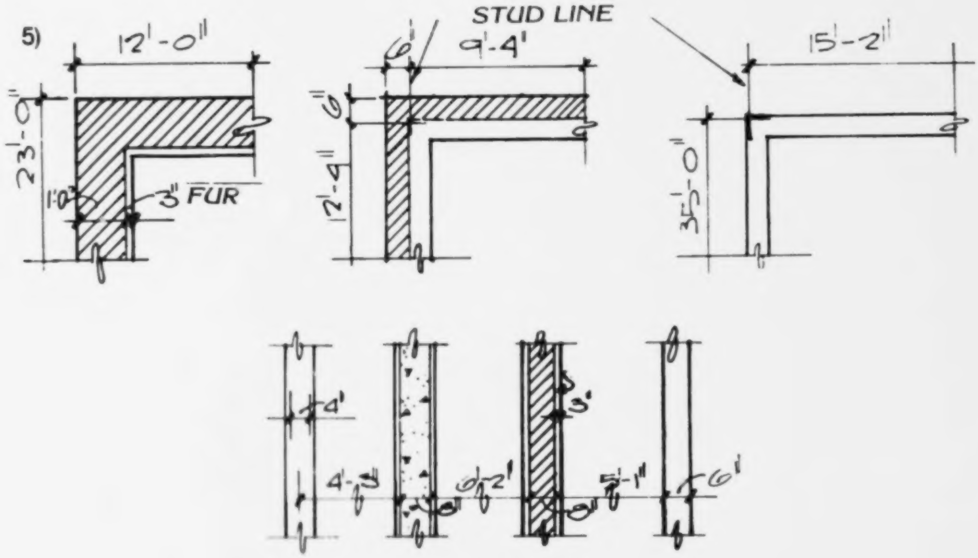
3)



4)

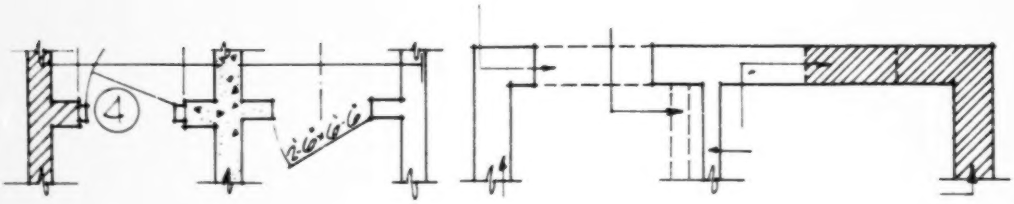


5)


12'-0"
23'-0"
1'-0"
3" FUR
STUD LINE
6"
9'-4'
6"
12'-4"
15'-2"
35'-0"
4'
4'-3"
8"
6'-2'
3'
8"
5'-1"
6'

TEST

6)



12. State four purposes of written specifications.

a. ______________________________
____

b. ______________________________
____

c. ______________________________
____

d. ______________________________
____

13. List seven items of basic information included in a set of written specifications.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

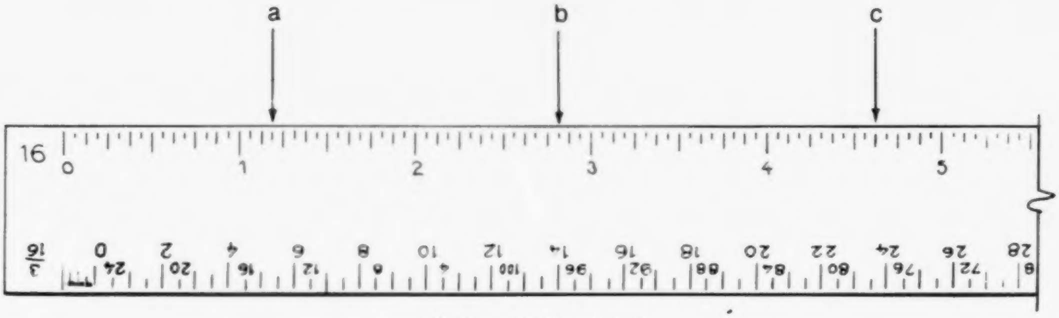
e. ______________________________

f. ______________________________

g. ______________________________

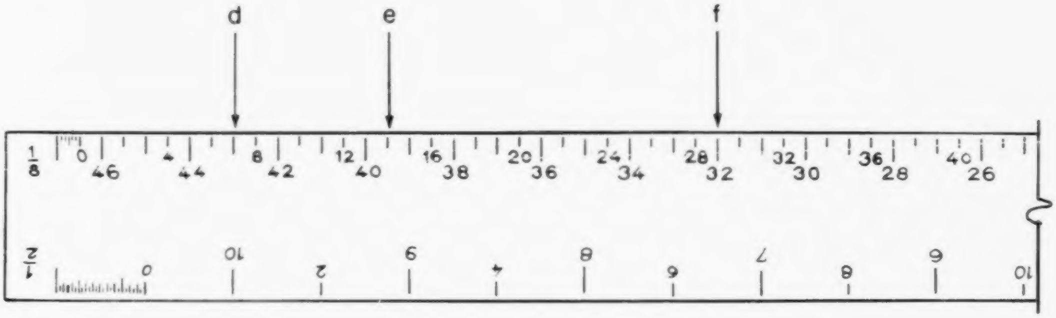
TEST

14. Read the measurements from zero to the letter points indicated on the following architect's scales. Use the scales given, and write the correct answers in the corresponding blanks.

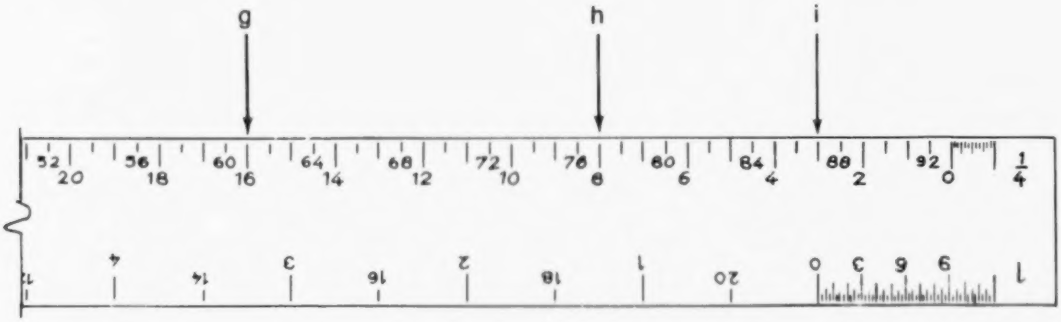

a
b
c
16
0
1
2
3
4
5
3/16

Scale — 1/16" = 1'-0"

a. ____________ b. ____________ c. ____________

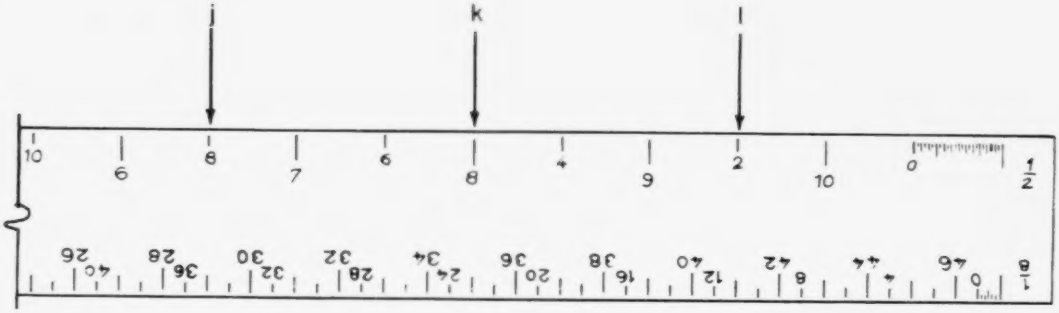


d. ____________ e. ____________ f. ____________

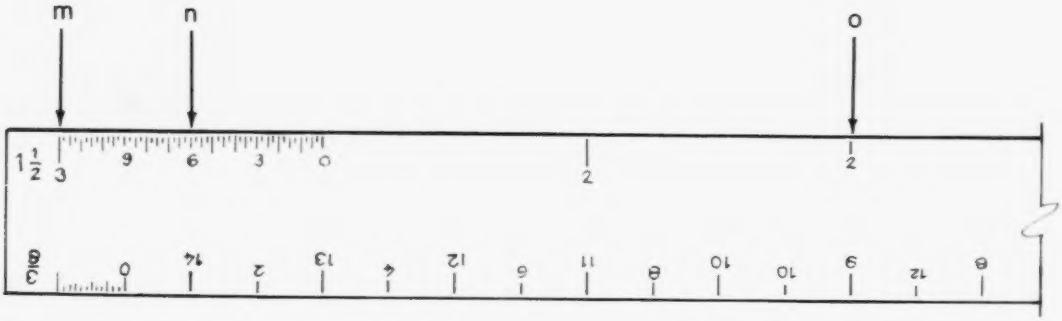


g. ____________ h. ____________ i. ____________

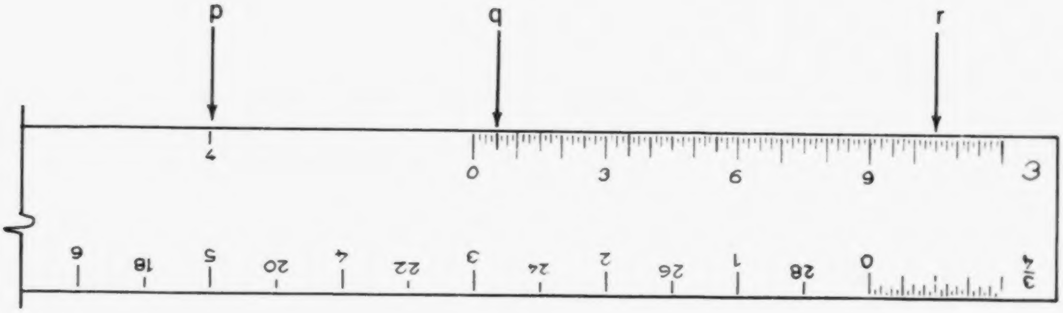
TEST



j. ____________ k. ____________ l. ____________

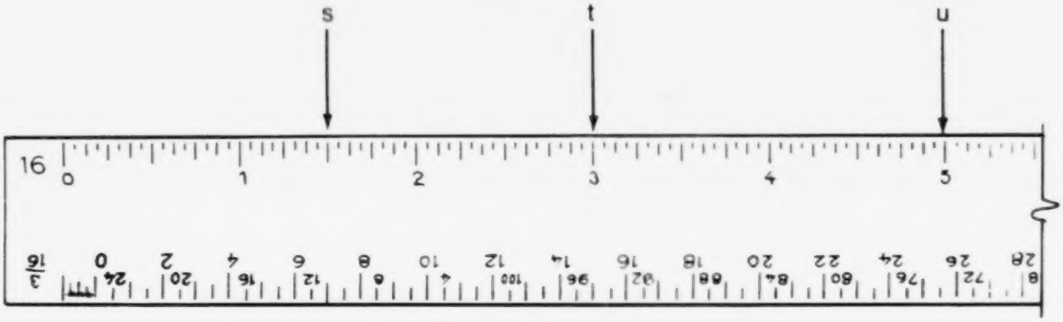


m. ____________ n. ____________ o. ____________



p. ____________ q. ____________ r. ____________

TEST



Scale — 12" = 1'-0"

s. ____________________ t. ____________________ u. ____________________

(NOTE: Test questions 15 and 16 list the assignment sheets that are considered an important part of this test. If they have not been completed, check with your instructor.)

15. Read plans.

16. Read written specifications.

BASIC PLAN READING
UNIT IV

ANSWERS TO TEST

1. a. 11
   b. 2
   c. 12
   d. 8
   e. 4
   f. 9
   g. 6
   h. 10
   i. 3
   j. 5
   k. 7
   l. 1
   m. 13
   n. 18
   o. 16
   p. 15
   q. 14
   r. 17

2. a. 3
   b. 1
   c. 5
   d. 4
   e. 6
   f. 2
   g. 9
   h. 7
   i. 8

3. a. Plot plan (Answer should include any four of the following)

      1) Location, dimensions, and elevation of structure on site
      2) Finished and existing grade contours
      3) Property lines and dimensions
      4) Location of utilities
      5) Location of existing conditions
      6) Location and dimensions of driveways and walks

   b. Foundation plan (Answer should include the following)

      1) Location and dimensions of footings, grade beams, foundation walls, stem walls, piers, equipment footings, and foundations
      2) Location of anchor bolts (in detail view)

   c. Floor plan (Answer should include any five of the following)

      1) Outside walls, including location and dimensions of all exterior openings
      2) Types of construction materials
      3) Location of interior walls and partitions
      4) Location and swing of doors
      5) Stairways
      6) Location of windows

ANSWERS TO TEST

7) Location of cabinets, electrical and mechanical equipment, fixtures
8) Location of cutting plane line

d. Elevation (Answer should include any four of the following)

1) Grade lines
2) Floor height
3) Window and door types
4) Roof lines and slope, roofing material, vents, gravel stops, projection of eaves
5) Exterior finish materials and trim
6) Exterior dimensions

e. Section (Answer should include any three of the following)

1) Details of construction and information about stairs, walls, chimneys, or other parts of construction that may not show clearly on plan
2) Floor levels in relation to grade
3) Wall thickness at various locations
4) Anchors and reinforcing steel

f. Detail (Answer should include any six of the following)

1) Footings and foundations, including anchor bolts, reinforcing, control joints
2) Beams, floor joists, bridging, other support members
3) Sills, floor framing, exterior walls, vapor barriers
4) Floor heights, thickness, expansion, reinforcing
5) Interior walls
6) Windows, exterior and interior doors, door frames
7) Roof, cornice, soffit, ceilings
8) Gravel stops, fascia, flashing
9) Fireplaces, chimneys
10) Staircases, stair assembly
11) Millwork, trim, ornamental iron, specialty items

4. a. 7
b. 8
c. 5
d. 4
e. 9
f. 3
g. 6
h. 1
i. 2

5. f Object line
e Dimension line
h Extension lines
b Hidden line
c Center line
d Cutting plane (section line)
g Break line
i Phantom line
a Leader line

ANSWERS TO TEST

6. a. Glazed clay tile
   b. Rough wood
   c. Common brick
   d. Concrete block
   e. Glass block
   f. Cut stone or sand/mortar/plaster
   g. Board or quilt insulation
   h. Earth
   i. Gravel
   j. Concrete
   k. Reinforcing bars
   l. Gravel with sand
   m. Loose fill or batt insulation
   n. Spray foam
   o. Structural steel
   p. Waterproofing, felt, flashing, expansion, etc.

7. a. 1. Fan outlet, ceiling
      2. Surface incandescent, wall
      3. Junction box, ceiling
      4. Surface or pendant single fluorescent fixture
      5. Exit light outlet, wall
      6. Combination ceiling incandescent, vent and heater

   b. 1. Special-purpose receptacle outlet, single
      2. Switch and single receptacle
      3. Duplex receptacle outlet
      4. Single receptacle outlet
      5. Television outlet
      6. Special-purpose outlet, clothes dryer

   c. 1. Low-voltage system switch
      2. Switch and pilot light
      3. Double-pole switch
      4. Automatic-door switch
      5. Weatherproof switch
      6. Single-pole switch

   d. 1. Chime
      2. Thermostat
      3. Telephone jack
      4. Bell and buzzer combination
      5. Kitchen ventilating fan
      6. Electric door opener

   e. 1. Meter
      2. Feeders
      3. Power panel
      4. Wiring concealed in floor
      5. Transformer
      6. Home run to panel board

8. a.
      1. Compressor
      2. Wall or space heater
      3. Unit heater (centrifugal)
      4. Pump
      5. Exposed radiator
      6. Thermostat
      7. Unit ventilation
      8. Automatic air vent
      9. Heat transfer surface
      10. Thermostatic trap

ANSWERS TO TEST

b. 1. Manual volume damper
2. Floor register
3. Supply outlet, ceiling diffuser
4. Direction of flow in duct
5. Supply duct section
6. Lined ductwork
7. Linear diffuser
8. Louver opening

c. 1. Fuel oil return
2. Gas line, high pressure
3. Hot-water heating return
4. Gas line, low pressure

9. a. 1. Water closet, low tank
2. Shower head
3. Urinal, wall type
4. Shower stall
5. Hot water heater
6. Built-in lavatory
7. Corner bath
8. Wall-type drinking fountain

b. 1. Floor cleanout
2. Hose bib
3. Manhole drain
4. Garage floor drain
5. Grease separator
6. Vacuum outlet
7. Meter
8. Floor drain
9. Gas outlet
10. Pipe cleanout

c. 1. Combination waste and vent line
2. Gas line
3. Vent line
4. Sewer cast-iron line
5. Soil waste or leader line, above grade
6. Cold water line

d. Septic system

10. a. Center to center
b. Masonry opening
c. Concrete block
d. Centerline
e. Excavate
f. Center to center
g. Beam
h. Detail not to scale
i. Risers
j. Reinforced concrete
k. Angle
l. Weephole, on center
m. Specifications
n. Structural steel
o. Benchmark
p. Kilowatt hours
q. Circuit breakers
r. Hose bib
s. Ornamental iron
t. Water closet
u. Cold water
v. Duct
w. Water heater
x. Receptacles
y. Sanitary
z. Insulation

11. a. 2
b. 4
c. 5
d. 3
e. 1
f. 6

ANSWERS TO TEST

12. Answer should include any four of the following

    a. Avoiding disputes among builders, architects, and owners by leaving no room for misinterpretation or misunderstanding
    b. Facilitating the checking of materials and workmanship during time that building is being constructed
    c. Enabling contractors to make bids based on total materials and labor required
    d. Avoiding expensive omissions when estimating total costs
    e. Avoiding conflicting opinions during construction and avoiding the added cost and delays that could result

13. Answer should incude any seven of the following.

    a. Contract
    b. General requirements
    c. Owner's name and address
    d. Architect's name
    e. Location of structure
    f. Completion date
    g. Contractor's bid form
    h. Guarantees
    i. Insurance requirements
    j. Methods of construction
    k. Sizes
    l. Tolerances
    m. Types, quality, and descriptions of materials

14. a. 19'–0"
    b. 45'–0"
    c. 74'–0"
    d. 7'–0"
    e. 14'–0"
    f. 29'–0"
    g. 16'–0"
    h. 8'–0"
    i. 3'–0"
    j. 8'–0"
    k. 5'–0"
    l. 2'–0"
    m. 1'–0"
    n. 6"
    o. 2'–0"
    p. 6"
    q. ½"
    r. 10½"
    s. 1½"
    t. 3"
    u. 5"

15. Evaluated to the satisfaction of the instructor

16. Evaluated to the satisfaction of the instructor

BUILDER'S LEVEL AND TRANSIT
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to use a builder's level, combination level transit, and transit. The student will show this knowledge by completing the assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with leveling instruments.
2. Match to their correct definitions terms associated with surveying.
3. Explain *stadia reticle*.
4. List uses of a level.
5. Identify types of levels.
6. Identify parts of a builder's level.
7. List uses of a transit.
8. Identify types of transits.
9. Label major components of an engineer's transit.
10. Identify parts of an engineer's transit.
11. Label vertical and horizontal cross hairs and line of sight on a leveling instrument.
12. State rules for proper care of leveling instruments.
13. Identify parts of a leveling rod.
14. Match parts of a leveling rod to their correct uses.
15. Describe commonly used direct-reading rods.
16. Read a direct-reading rod.

OBJECTIVE SHEET

17. Identify hand signals used by the instrument person to guide the rod person.

18. Demonstrate the ability to

    a. Set up and adjust a builder's level.

    b. Connect plumb bob to transit.

    c. Set up and adjust a combination level-transit.

    d. Use a combination level-transit to locate building-line points on batter boards.

BUILDER'S LEVEL AND TRANSIT
UNIT V

SUGGESTED ACTIVITIES

I. Unit contents

- A. Objective sheet
- B. Suggested activities
- C. Transparency master: TM #1 — Certification Card Example
- D. Information sheet
- E. Assignment sheets
    - 1. Assignment Sheet #1 — Read Leveling Rods
    - 2. Assignment Sheet #2 — Distinguish Among Hand Signals Used by the Instrument Person to Guide the Rod Person
- F. Answers to assignment sheets
- G. Job sheets
    - 1. Job Sheet #1 — Set Up and Adjust a Builder's Level
    - 2. Job Sheet #2 — Connect Plumb Bob to Transit
    - 3. Job Sheet #3 — Set Up and Adjust a Combination Level-Transit
    - 4. Job Sheet #4 — Use a Combination Level-Transit to Locate Building-Line Points on Batter Boards
- H. Test
- I. Answers to test

II. Instructor's guide

- A. Review unit and plan presentation.
    - 1. Gather tools and equipment used in Job Sheets #1-#4.
    - 2. Review Job Sheet #4. You will need to locate a site, mark property-line points, and erect batter boards as shown in the drawings accompanying the job sheet.
- B. Obtain materials to supplement unit.
    - 1. Competency profiles

      (NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

SUGGESTED ACTIVITIES

2. Filmstrips

   (NOTE: The following color filmstrips come with a manual and may be ordered from the California State Polytechnic University, San Luis Obispo, California 93407.)

   a. *Setting Up the Instrument.*

   b. *Reading the Rod.*

C. Introduce unit to students.

- Invite an instrument salesperson or a surveyor to display and discuss the cost, use, and proper care of the various types of leveling instruments.
- Visit a construction site to let the students observe leveling instruments in use.
- Explain to students that the instruments may look complicated but are relatively easy to use; emphasize that the instruments must be used carefully and skillfully in order to get accurate readings.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives.

F. Provide students with information, assignment, and job sheets.

G. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Sections I-III, to discuss terms and definitions associated with leveling instruments.
   - Show students actual instruments—such as a builder's level, laser-beam instrument, and transit—and examples of other objects—such as a field book, leveling rod, grade stake, and plumb bob.
   - Take the students to a construction site to demonstrate surveying and concepts such as slope, elevation, fall, benchmark, finish-floor height, grade line, etc.
   - Set up a transit and a builder's level, and have students look through the telescopes to reinforce your discussion of reticle and stadia, cross hairs, and line of sight.
   - Demonstrate stadia reticle.
2. Use Information Sheet, Section IV, to discuss uses of a level.
   - Compare the uses of transits and levels, emphasizing when it is more appropriate to use a level.

SUGGESTED ACTIVITIES

3. Use Information Sheet, Section V, to discuss types of levels.

   - Show students examples of the various types of levels illustrated in the information sheet.

   - Discuss the uses of the various types of levels, emphasizing the possible advantages and disadvantages of each type.

   - Explain to students that the automatic level and the laser-beam instrument are the types of levels that they will see being used on large construction jobs; however, the builder's level and the combination level-tranit are the two types that they will be most likely to use themselves.

   - Explain that a person must earn a certification card (show Transparency #1 as an example) before he or she can use a laser-beam instrument. Also explain that government regulations require a warning to be included on literature concerning laser-beam-instrument use.

4. Use Information Sheet, Section VI, to discuss the parts of a builder's level.

   - Explain to students that the automatic and laser beam levels are the types of levels that they are most likely to encounter on the job.

   - Set up a builder's level, point out the parts of the level illustrated in the information sheet, and demonstrate all movements of the instrument.

5. Use Information Sheet, Section VII, to discuss uses of a transit.

   - Compare the uses of transits and levels, emphasizing when it is more appropriate to use a transit.

6. Use Information Sheet, Section VIII, to discuss types of transits.

   - Show the students examples of the various types of transits illustrated in this section of the information sheet.

   - Discuss the level-transit, emphasizing that, as the name suggests, it is a combination tool that is becoming very popular in construction.

   - Discuss the uses of the various types of transits, emphasizing the possible advantages and disadvantages of each type.

7. Use Information Sheet, Sections IX and X, to discuss the major components and parts of an engineer's transit.

   - Explain to students that the engineer's transit is the type of transit that they are most likely to encounter on the job.

   - Set up an engineer's transit, point out the components and parts illustrated in the information sheet, and demonstrate all movements of the instrument.

SUGGESTED ACTIVITIES

8. Use Information Sheet, Section XI, to discuss vertical and horizontal cross hairs and line of sight on a leveling instrument.

   - Set up various leveling instruments and allow students to sight through each instrument to identify vertical and horizontal cross hairs and to locate line of sight.

9. Use Information Sheet, Section XII, to discuss the proper care of leveling instruments.

   - Discuss the cost of leveling instruments and emphasize the delicacy of the instruments.

   - Show the filmstrip *Setting Up the Instrument.*

   - Demonstrate to students the proper procedure for removing a builder's level from its carrying case and for setting up the instrument; acquaint students with your rules for student use of the instrument.

   - Have students complete Job Sheet #1. Have students practice setting up and adjusting the instrument. After instrument is set up, have the students become familiar with it by adjusting the focusing screw and the eyepiece focusing ring.

   - Demonstrate to students the proper procedures for removing transits and level-transits from their carrying cases, setting up the instruments, and attaching a plumb bob to the instruments; acquaint students with your rules for student use of the instruments.

   - Have students complete Job Sheet #2. Have students connect plumb bob to transit, then practice tying the knot until they can do it properly without the instructions.

10. Use Information Sheet, Section XIII and XIV, to discuss the parts of a leveling rod and their correct uses.

    - Use an actual rod to point out the parts illustrated in the information sheet and to demonstrate the correct use of each part.

11. Use Information Sheet, Section XV, to discuss commonly used direct-reading rods.

    - Show the students an example of each type of direct-reading rod and discuss when it is more appropriate to use one or the other.

    - Show the filmstrip *Reading the Rod.*

12. Use Information Sheet, Section XVI, to discuss reading a direct-reading rod.

    - Have students practice reading a direct-reading rod by completing Assignment Sheet #1.

SUGGESTED ACTIVITIES

13. Use Information Sheet, Section XVII, to discuss hand signals used by the instrument person to guide the rod person.
    - Demonstrate each of the hand signals illustrated in the information sheet.
    - Have students practice recognizing hand signals by completing Assignment Sheet #2.
    - Allow the students to practice giving the signals to each other in the shop or in the field.
14. Have students review material presented in Information Sheet, Sections XI through XVII, and then divide class into teams of two to complete Job Sheets #3 and #4.
    - Have students practice using a combination level-transit to locate points by turning 90-degree corners, establishing new set-up locations, and continuing to turn 90-degree corners.

H. Review information.

I. Give test.

J. Critique test and discuss in class.

K. Complete appropriate section of competency profiles.

III. Unit reference

Hendrix, Laborn J. "Bud." *Fundamentals of Carpentry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1985.

Certification Card Example

realist

David White Instruments

16288 Megal Drive, Menomonee Falls, WI 53051
(414) 251-8100

THIS IS TO CERTIFY THAT

____

has been instructed in the safe use, care, and operation of the instruments listed and is capable of operating them in the applications for which they are intended.

____

PRODUCT INSTRUCTOR DATE

INSTRUCTIONS FOR SAFE LASER USE

1. Do not look into the laser or allow others to do so.
2. Do not point the laser at others or into areas where others' eyes can be exposed to the beam.
3. Post standard laser warning placards in area where laser is to be used.
4. Do not allow unauthorized personnel access to the laser unit.
5. Do not point the laser at smooth reflecting surfaces.
6. Avoid whenever feasible placement of the laser-beam path at or near eye level.
7. Turn the laser off when it is not required for substantial periods of time such as during lunch hour, overnight, or at change of shifts.

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BUILDER'S LEVEL AND TRANSIT
UNIT V

INFORMATION SHEET

I. Terms associated with leveling instruments

   A. **Builder's level** — Leveling instrument consisting of a telescope and leveling bubble; used with a tripod and leveling rod primarily for establishing grade levels

   B. **Cross hairs** — Fine horizontal and vertical lines in telescope of leveling instrument; used as reference lines in the field or for marking instrumental axis

   C. **Differential leveling** — Leveling method by which the difference in elevation between two points is determined by plus and minus rod readings that are totaled and adjusted to benchmark

   D. **Height of instrument (HI)** — Vertical distance from benchmark to line of sight of leveling instrument

   E. **Laser-beam instrument** — Automatic level that uses a laser beam to establish elevation readings

   F. **Leveling rod** — Rod used with leveling instrument; graduated in tenths and hundredths of a foot or in inches and feet

   G. **Line of sight** — Line from an observer's eye to a distant point toward which he or she is directing a leveling instrument

   H. **Plumb bob** — Tool or device attached to a string; used to set and check the vertical or perpendicular of a surface

   I. **Reticle** — System of lines or cross hairs in the focus of the eyepiece of an optical instrument

   J. **Transit** — Very precise leveling instrument used to establish straight lines and to measure horizontal and vertical angles

II. Terms associated with surveying

   A. **Benchmark (BM)** — Permanent point of known or assumed elevation

   (NOTE: The benchmark may be a specific point on a curb or culvert.)

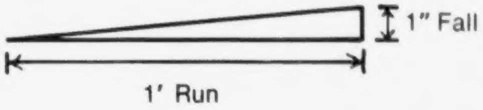
   B. **Elevation** — Given grade

   C. **Fall** — Difference between elevations of two points on a slope (Figure 1)

   (NOTE: The fall is usually expressed in inches per foot.)

   EXAMPLE: One-inch fall per 1 foot of run

FIGURE 1



INFORMATION SHEET

D. **Field book** — Small book used to record instrument readings for layout and elevations of proposed structures

E. **Finish-floor height** — Elevation of finished floor in relation to benchmark

F. **Grade line** — Proposed or future level of ground at construction line

G. **Grade Stake** — Stake driven into ground, usually with top establishing finished level of ground or concrete at that point

(NOTE: The grade stake is read from the benchmark.)

H. **Magnetic bearing** — Bearing relative to magnetic north

I. **Site** — Plot of ground on which a project is to be constructed

J. **Stadia** — Surveying method for determining distances and differences of elevation through means of a transit and rod

K. **Surveying** — Art or science of determining area and configuration of portions of the earth's surface with a maximum of accuracy

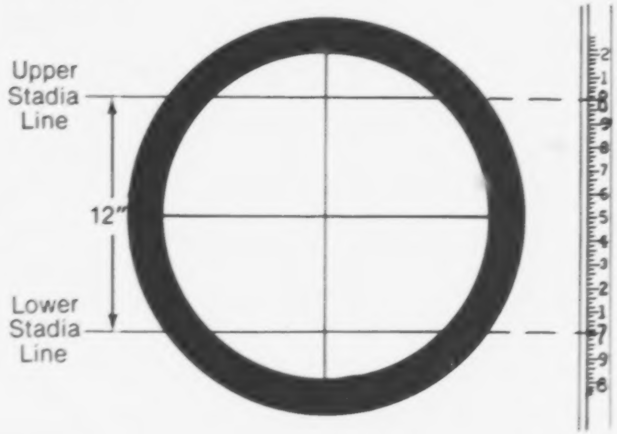
L. **Temporary benchmark (TBM)** — Elevation reference point used when the permanent point is not in sight

III. **Stadia reticle** — Additional horizontal lines in telescope eyepiece; used to determine distance between leveling rod and plumb bob (Figure 2)

(NOTE: Stadia ratio is 1:100, which indicates that the rod reading between the upper and lower stadia lines multiplied by 100 is the distance from center of the instrument to the rod.)

EXAMPLE:

FIGURE 2



Reading Between Stadia Lines: 8′ − 7′ = 1′

Distance from Rod to Plumb Bob: 1′ × 100 = 100′

INFORMATION SHEET

IV. Uses of a level

   A. Establishing elevations and grades

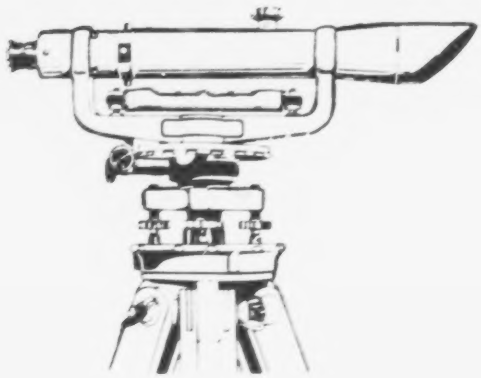
   B. Establishing differential elevations

   C. Transferring elevations from one point to another

V. Types of levels (Figures 3-9)

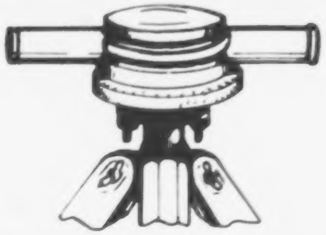
   A. Builder's level

   FIGURE 3



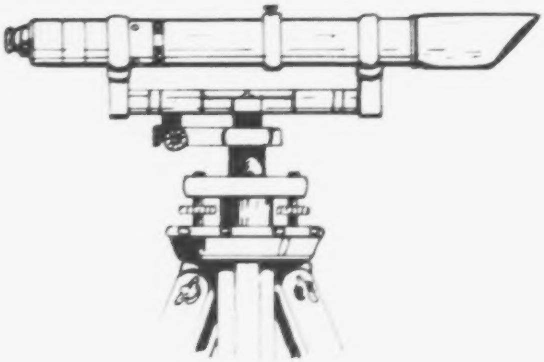
   B. Turret level

   FIGURE 4



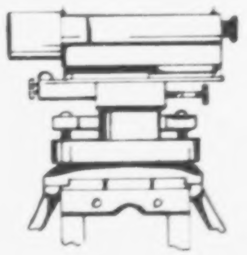
   C. Engineer's dumpy level

   FIGURE 5



   D. Engineer's wild-tilting level

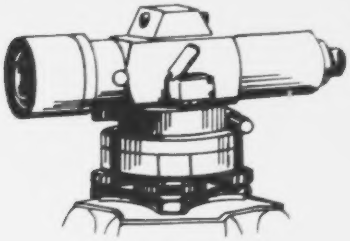
   FIGURE 6



INFORMATION SHEET

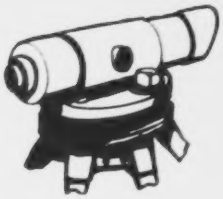
E. Automatic level

FIGURE 7



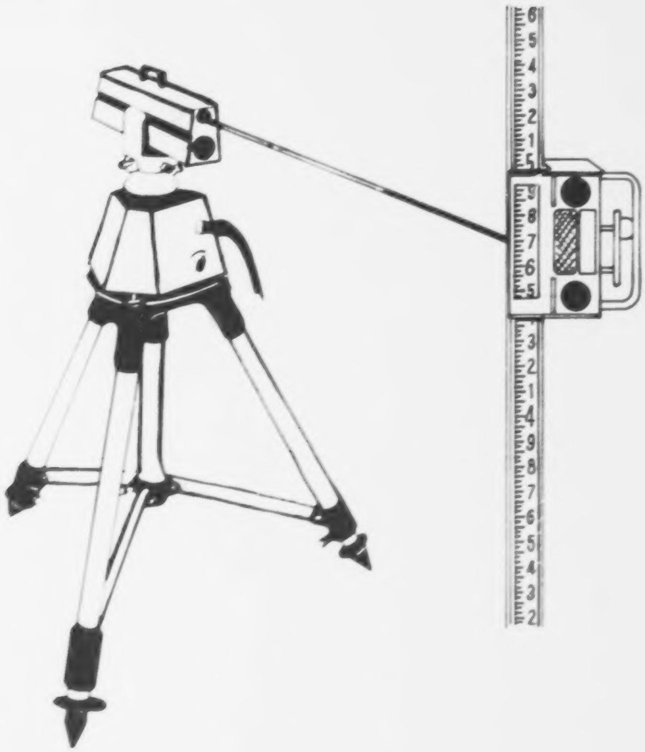
F. Engineer's Zeiss level

FIGURE 8



G. Laser-beam instrument

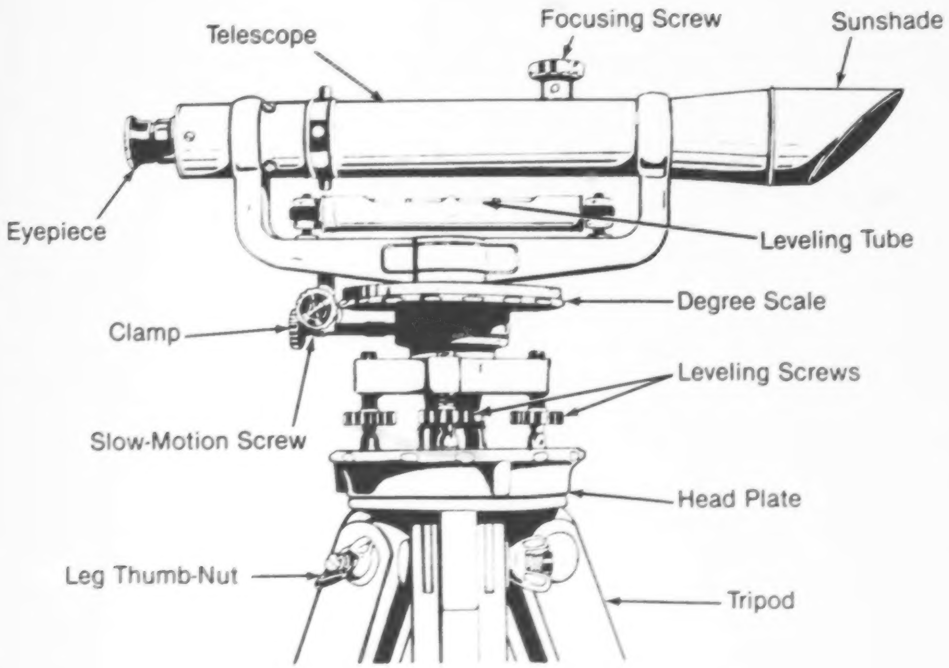
FIGURE 9


6 5 4 3 2 1 5
9 8 7 6 5
3 2 1 4 9 8 7 6 5 4 3 2

INFORMATION SHEET

VI. Parts of a builder's level (Figure 10)

FIGURE 10


Telescope
Focusing Screw
Sunshade
Eyepiece
Leveling Tube
Degree Scale
Clamp
Leveling Screws
Slow-Motion Screw
Head Plate
Leg Thumb-Nut
Tripod

VII. Uses of a transit

A. Measuring horizontal angles

B. Measuring vertical angles

C. Measuring elevations

D. Measuring horizontal and vertical distances

E. Determining magnetic bearings

F. Laying out boundaries and building lines

G. Establishing elevations and grades

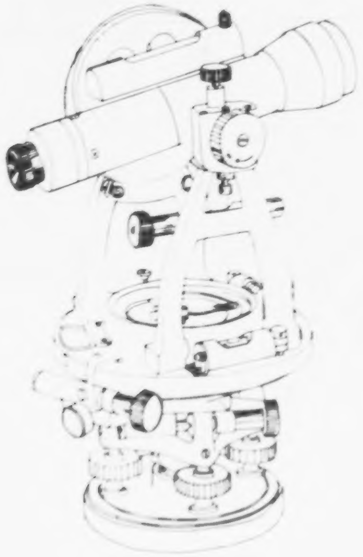
(NOTE: A builder's level is the preferred instrument for establishing grades, but a transit can be used if a level is not available.)

INFORMATION SHEET

VIII. Types of transits (Figures 11-14)

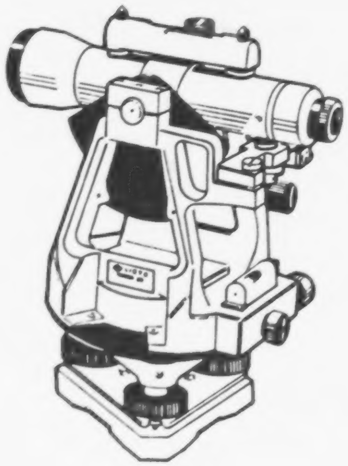
A. Engineer's transit

FIGURE 11



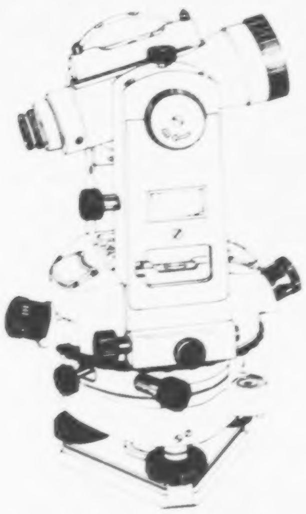
B. Combination level-transit

FIGURE 12



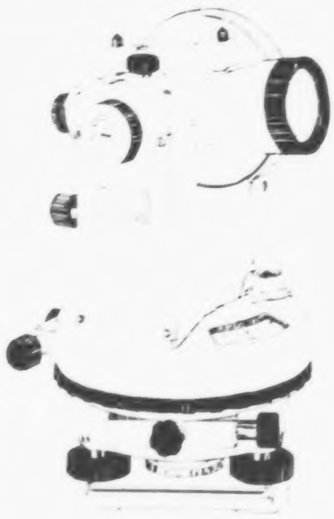
C. Optical transit

FIGURE 13



D. Optical plummet transit

FIGURE 14



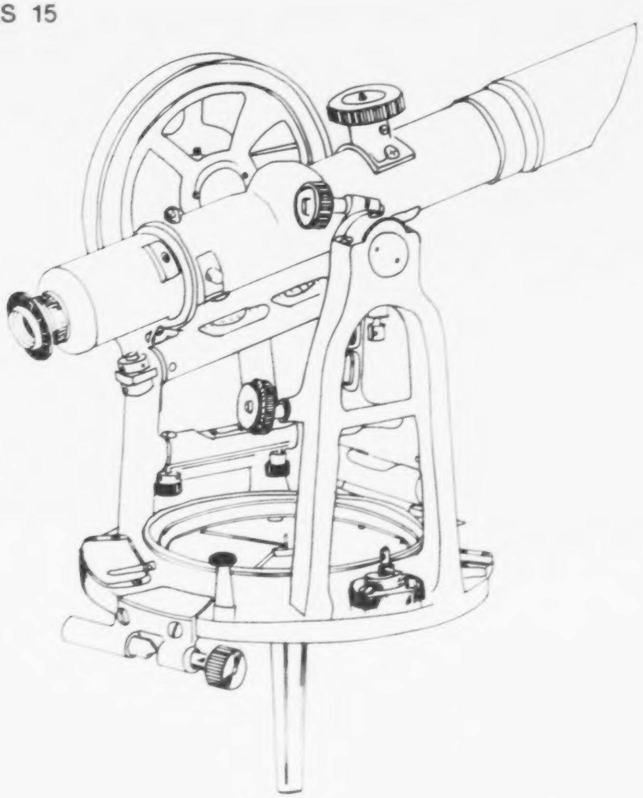
Figures 11-14 used with permission of The Lietz Company, Overland Park, Kansas.

INFORMATION SHEET

IX. Major components of an engineer's transit (Figures 15-17)

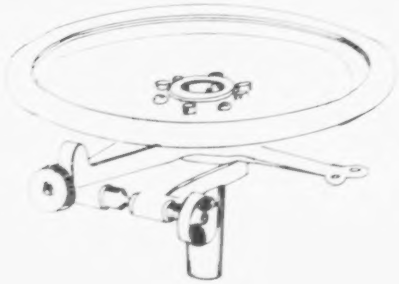
A. Alidade

FIGURES 15



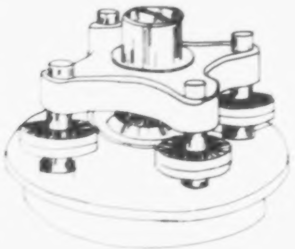
B. Horizontal circle

FIGURE 16



C. Leveling head

FIGURE 17

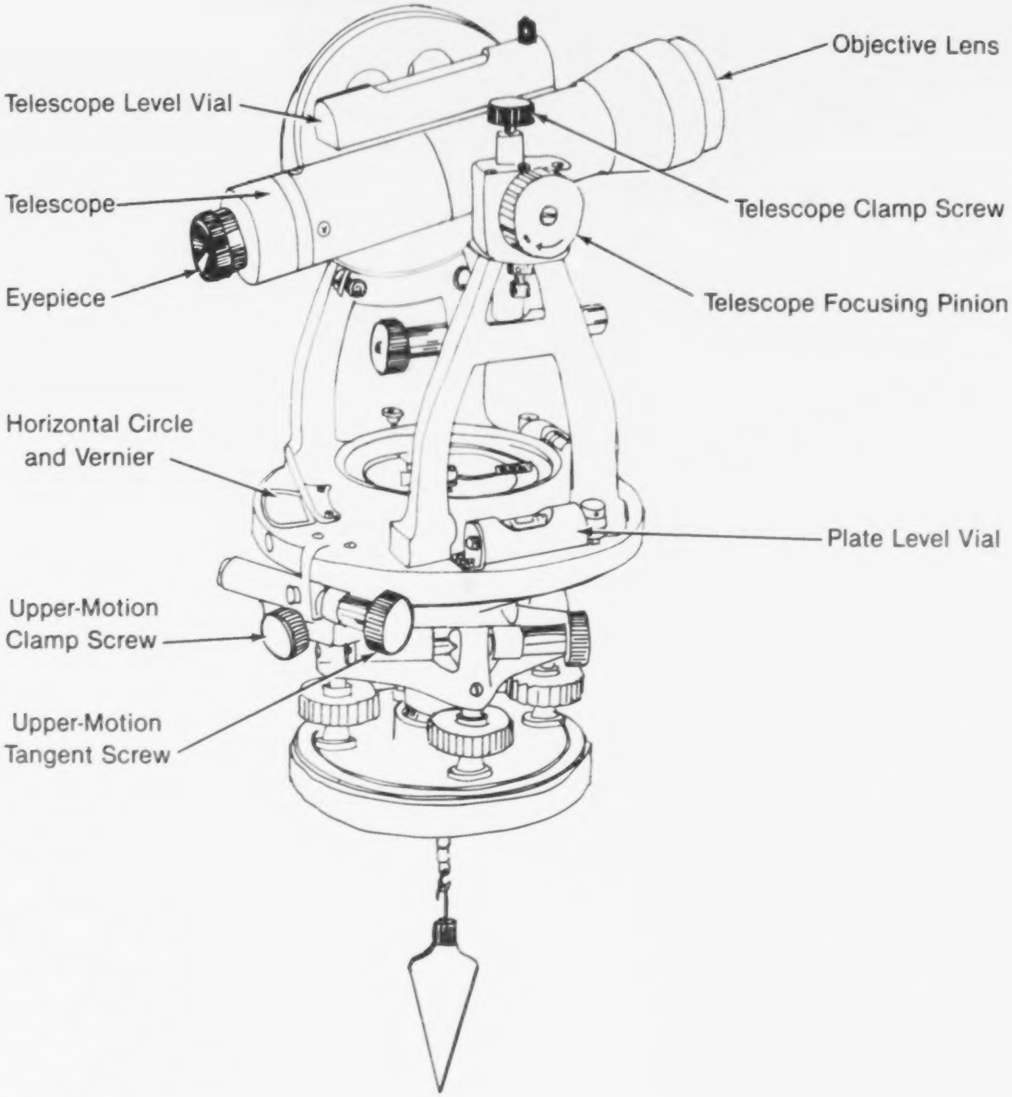


INFORMATION SHEET

X. Parts of an engineer's transit (Figures 18 and 19)

View A

FIGURE 18

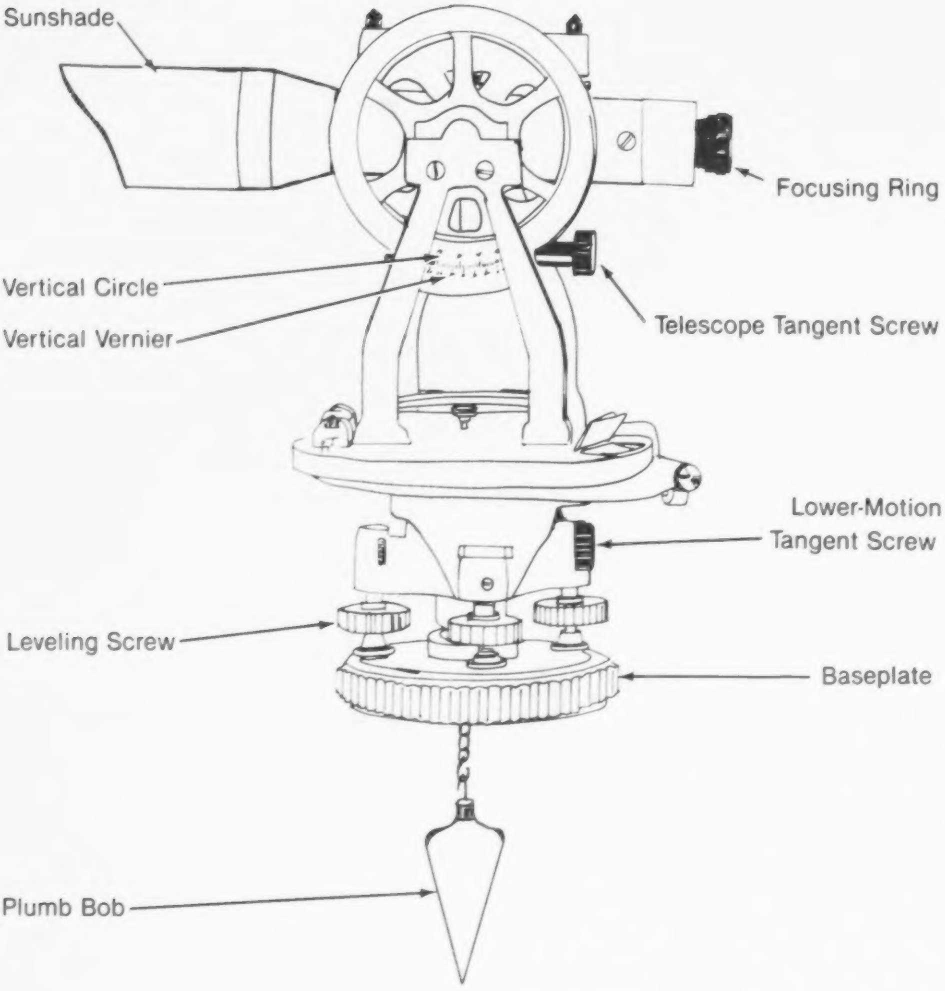

Objective Lens
Telescope Level Vial
Telescope
Telescope Clamp Screw
Eyepiece
Telescope Focusing Pinion
Horizontal Circle and Vernier
Plate Level Vial
Upper-Motion Clamp Screw
Upper-Motion Tangent Screw

Adapted with permission of The Lietz Company, Overland Park, Kansas.

INFORMATION SHEET

View B

FIGURE 19


Sunshade
Focusing Ring
Vertical Circle
Vertical Vernier
Telescope Tangent Screw
Lower-Motion Tangent Screw
Leveling Screw
Baseplate
Plumb Bob

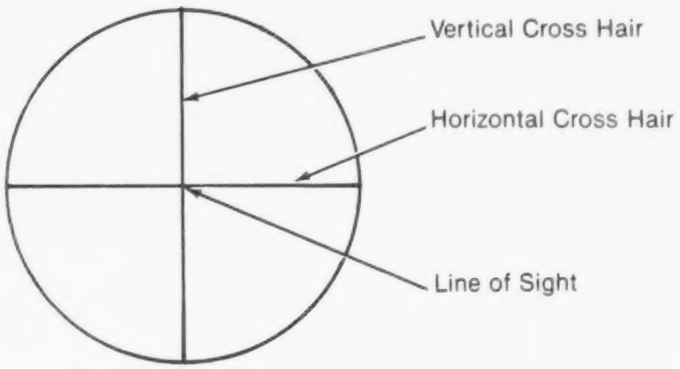
Adapted with permission of The Lietz Company, Overland Park, Kansas.

INFORMATION SHEET

XI. Vertical and horizontal cross hairs and line of sight on a leveling instrument (Figure 20)

(NOTE: Vertical cross hairs indicate direction. Horizontal cross hairs indicate the flat plane. The point where the vertical and horizontal cross hairs meet indicates line of sight.)

FIGURE 20



XII. Rules for proper care of leveling instruments

(NOTE: Leveling instruments are sensitive instruments that require extremely careful treatment.)

A. Keep instrument in carrying case when not in use

B. Protect instrument from shock and vibration when transporting

C. Remove instrument from carrying case by lifting the level bar or baseplate

(NOTE: Never grasp the telescope barrel while removing instrument from the carrying case.)

D. Never force screws or other moving parts of the instrument

E. Place lens and tripod caps in carrying case after removing them from instrument

F. Do not remove lenses

G. Clean lenses with soft tissue only

H. Always use sunshade regardless of weather

I. Loosen leveling screws before returning instrument to carrying case

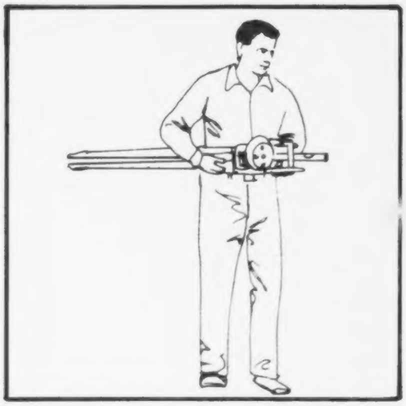
INFORMATION SHEET

J. Carry tripod under your arm with the instrument in front of you (Figure 21)

(NOTE: Never carry tripod over your shoulder when instrument is attached.)

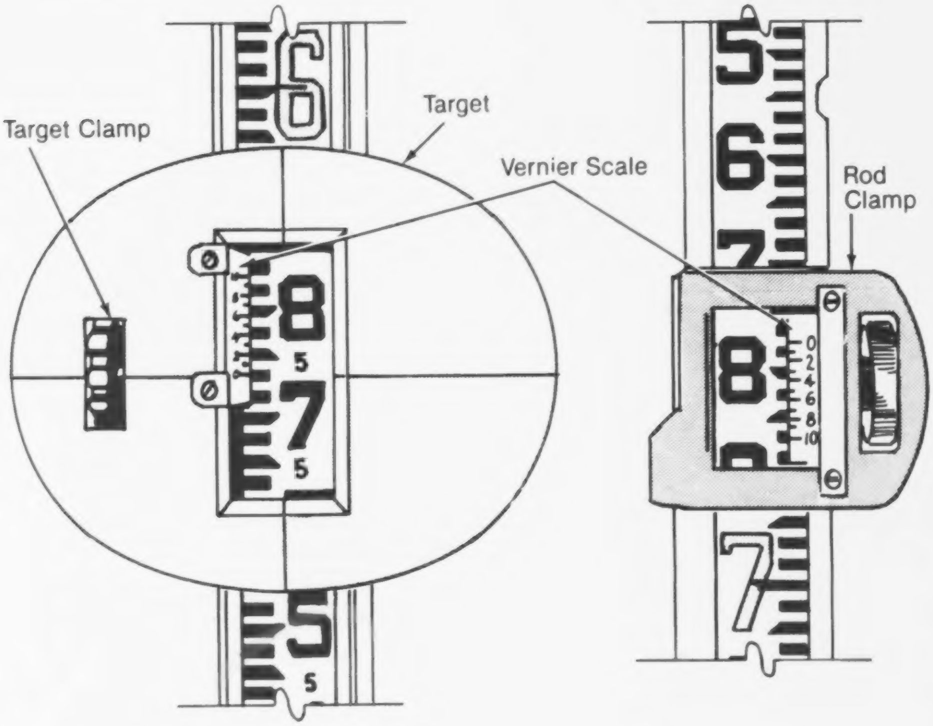
EXAMPLE:

FIGURE 21



XIII. Parts of a leveling rod (Figures 22 and 23)

FIGURE 22: Front view FIGURE 23: Back view


Target Clamp
Target
Vernier Scale
Rod Clamp

INFORMATION SHEET

XIV. Uses of parts of a leveling rod

A. **Target** — Helps make measurements within a certain range on leveling rod; holds vernier scale

(NOTE: The target is usually a red and white disk that slides up and down on the rod.)

B. **Target clamp** — Holds target in place

C. **Rod clamp** — Holds rod open when extended

D. **Vernier scale** — Enables reading to the nearest thousandth of a foot or nearest sixty-fourth of a foot

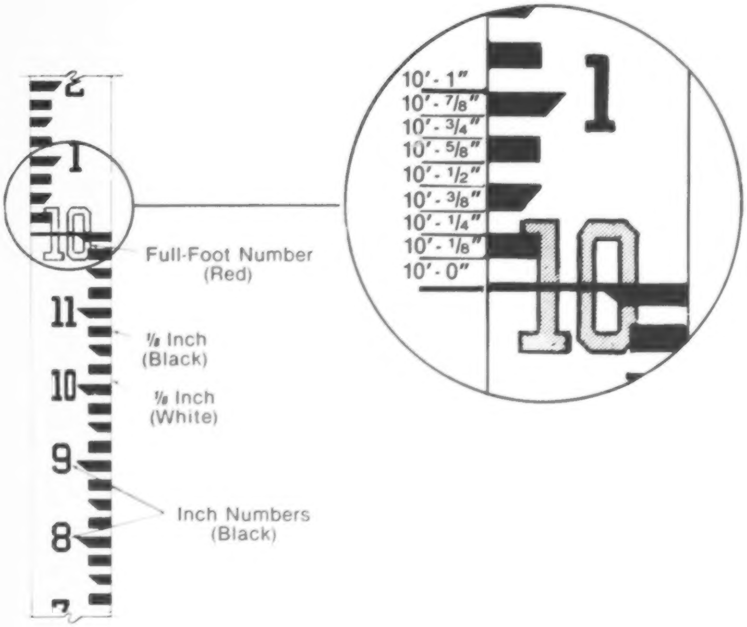
XV. Commonly used direct-reading rods

(NOTE: There are many types of leveling rods, but the two types of direct-reading rods described below are the ones most commonly used.)

A. Rod graduated in eighths of an inch — Marks indicate feet, inches, and eighths of an inch; each line and each space is one-eighth of an inch thick (Figure 24)

EXAMPLE:

FIGURE 24: Rod graduated in eighths of an inch



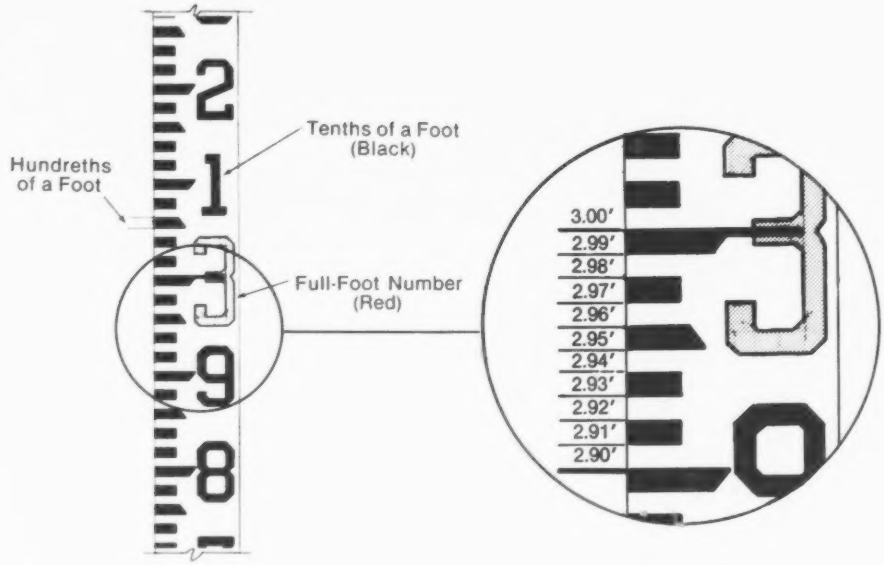
2
1
10
11
10
9
8
7
Full-Foot Number (Red)
1/8 Inch (Black)
1/8 Inch (White)
Inch Numbers (Black)
10'-1"
10'-7/8"
10'-3/4"
10'-5/8"
10'-1/2"
10'-3/8"
10'-1/4"
10'-1/8"
10'-0"
1
10

INFORMATION SHEET

B. Rod graduated in hundredths of a foot — Marks indicate feet, tenths of a foot, and hundredths of a foot; each line and each space is one hundredth of a foot thick (Figure 25)

EXAMPLE:

FIGURE 25: Rod graduated in hundredths of a foot


2
1
3
9
8
Hundreths of a Foot
Tenths of a Foot (Black)
Full-Foot Number (Red)
3.00′
2.99′
2.98′
2.97′
2.96′
2.95′
2.94′
2.93′
2.92′
2.91′
2.90′

XVI. Reading a direct-reading rod (Figures 26 and 27)

A. Marks at large red numbers indicate full feet

(NOTE: Some rods also have small running-foot numbers spaced at intervals between the large red full-foot numbers.)

B. Marks at small black numbers indicate full inches or tenths of a foot (0.1 foot), depending on rod used

INFORMATION SHEET

C. Black marks and spaces between full-inch or full-tenth-of-a-foot marks indicate eighths of an inch or hundredths of a foot (0.01 foot), depending on rod used

EXAMPLES:

FIGURE 26: Reading a rod graduated in eighths of an inch

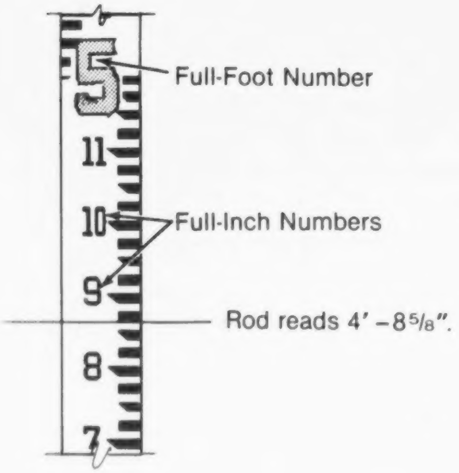
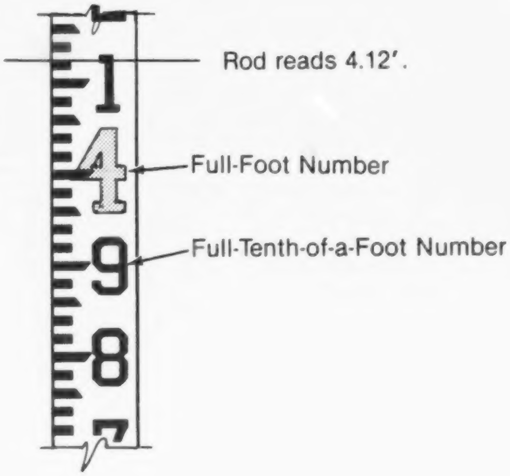

5
Full-Foot Number
11
10
Full-Inch Numbers
9
Rod reads 4′ –8 5/8″.
8
7

FIGURE 27: Reading a rod graduated in hundredths of a foot


Rod reads 4.12′.
1
4
Full-Foot Number
9
Full-Tenth-of-a-Foot Number
8
7

XVII. Hand signals used by the instrument person to guide the rod person (Figures 28-37)

A. Move in this direction

FIGURE 28

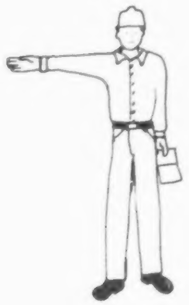
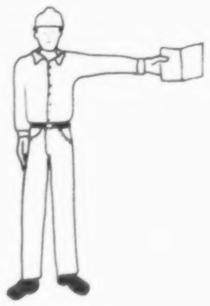


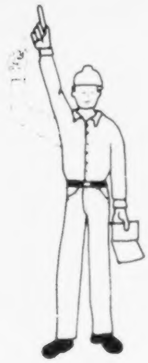
FIGURE 29



INFORMATION SHEET

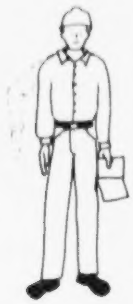
B. Move up

FIGURE 30



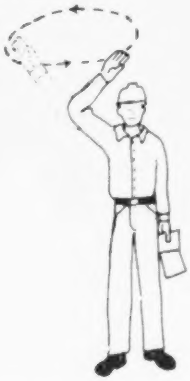
C. Move down

FIGURE 31



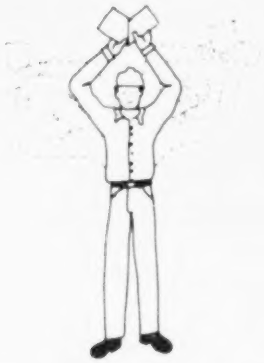
D. Turning point

FIGURE 32



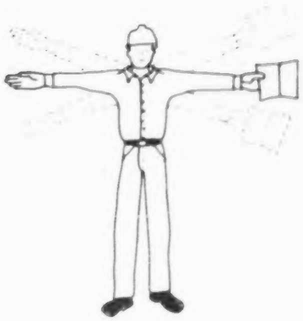
E. Wave rod from side to side

FIGURE 33



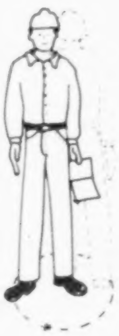
F. Observation completed; move on; understand

FIGURE 34



G. Wrong face; cleck clamp; rod upside down

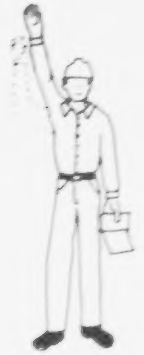
FIGURE 35



INFORMATION SHEET

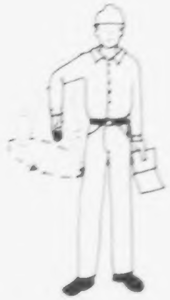
H. Use long rod

FIGURE 36



I. Come in

FIGURE 37



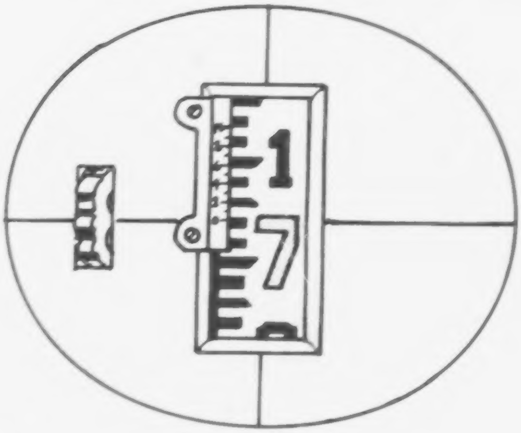
BUILDER'S LEVEL AND TRANSIT
UNIT V

ASSIGNMENT SHEET #1 — READ LEVELING RODS

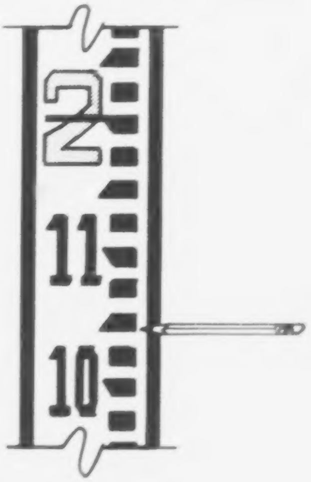
NAME ____ SCORE ________________

The leveling rod is a very important construction tool that is used with a leveling instrument to read elevations. With practice, the construction worker can become skilled at reading elevations and lines quickly and accurately.

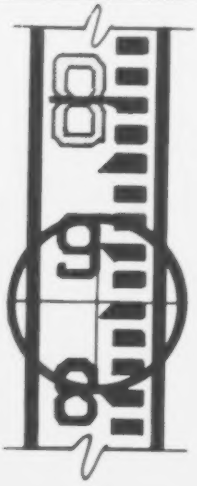
Read each of the following illustrations to the nearest eighth of an inch or hundredth of a foot, depending on the type of rod illustrated. Write the correct answers in the blanks.



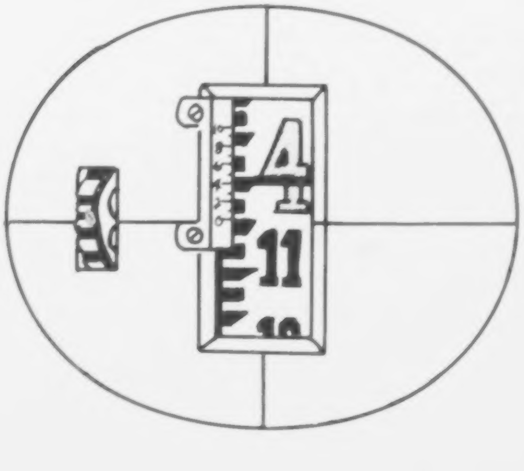
A. ________________________



B. ________________________



C. ________________________



D. ________________________

BUILDER'S LEVEL AND TRANSIT
UNIT V

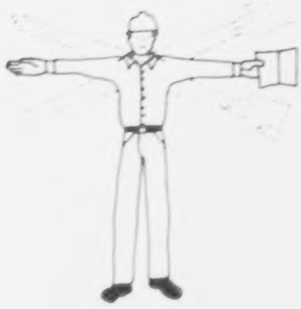
ASSIGNMENT SHEET #2 — DISTINGUISH AMONG HAND SIGNALS USED BY THE INSTRUMENT PERSON TO GUIDE THE ROD PERSON

NAME ______________________________ SCORE ______________

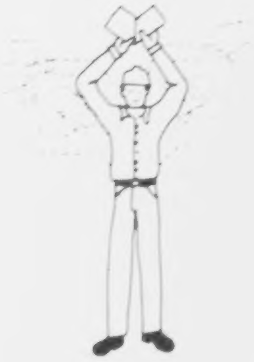
Knowing hand signals will save you many steps and much time when you are operating a leveling instrument.

Distinguish among the following hand signals used by the instrument person by writing an "X" in the blank under each correct illustration.

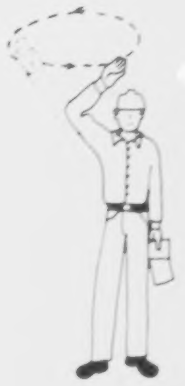
A. Wave rod from side to side



1. ______________

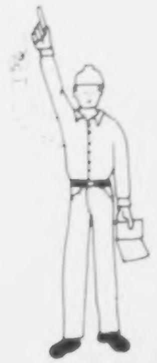


2. ______________

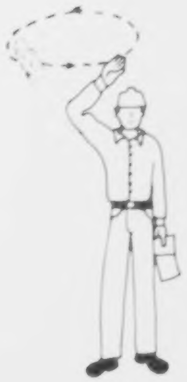


3. ______________

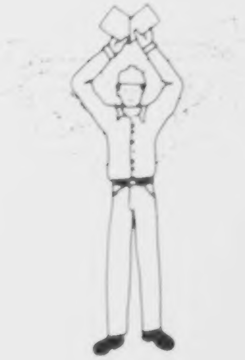
B. Move up



1. ______________



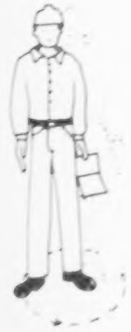
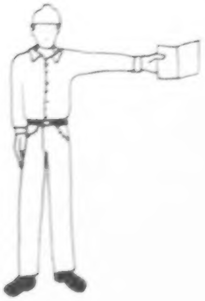
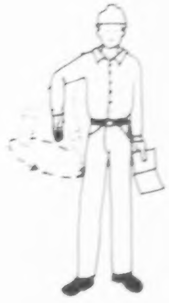
2. ______________



3. ______________

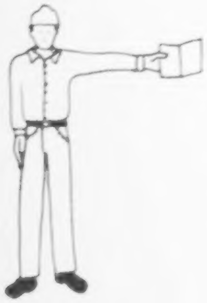
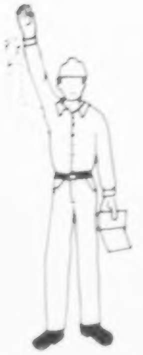
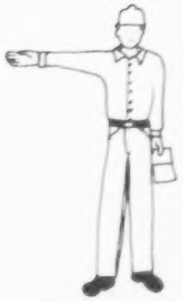
ASSIGNMENT SHEET #2

C. Come in

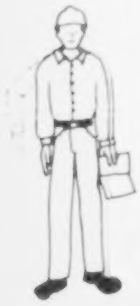
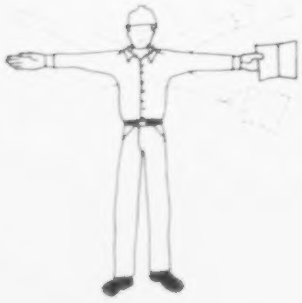
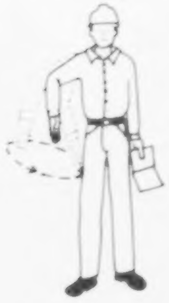
1. ______________ 2. ______________ 3. ______________

D. Move in this direction

1. ______________ 2. ______________ 3. ______________

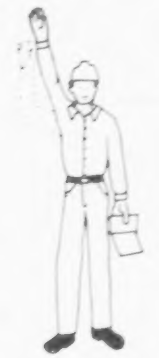
E. Observation completed

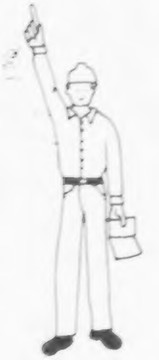




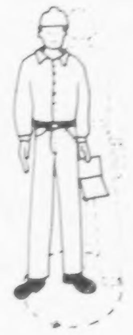
1. ______________ 2. ______________ 3. ______________

ASSIGNMENT SHEET #2

F. Rod upside down

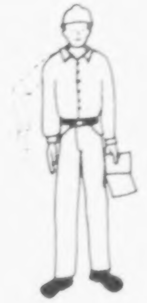


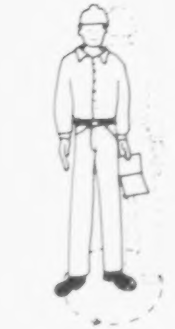


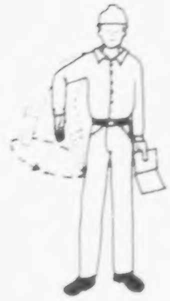


1. ____________________ 2. ____________________ 3. ____________________

G. Move down

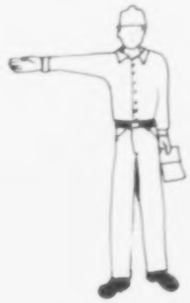


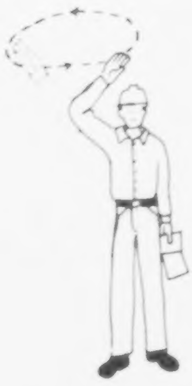


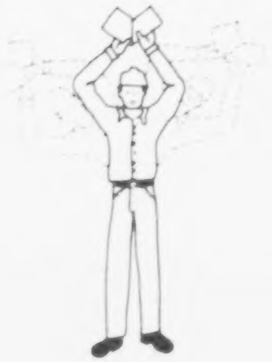


1. ____________________ 2. ____________________ 3. ____________________

H. Turning point



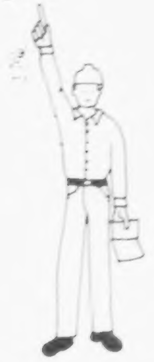


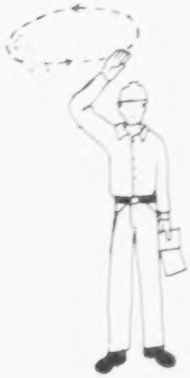


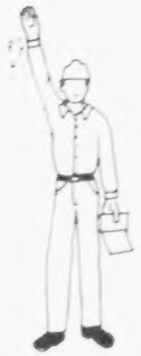
1. ____________________ 2. ____________________ 3. ____________________

ASSIGNMENT SHEET #2

I. Use long rod

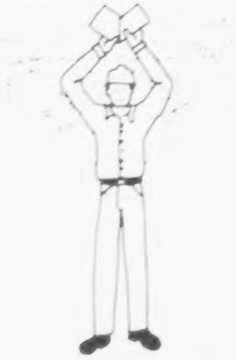


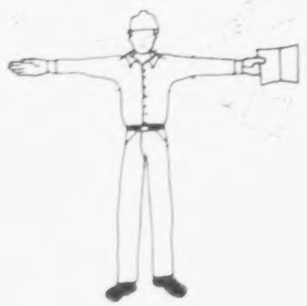


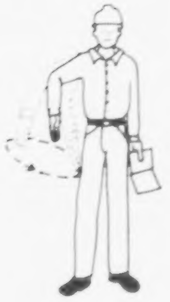


1. ____________________ 2. ____________________ 3. ____________________

J. Move on

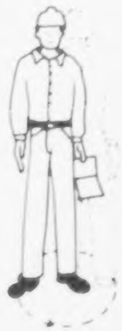


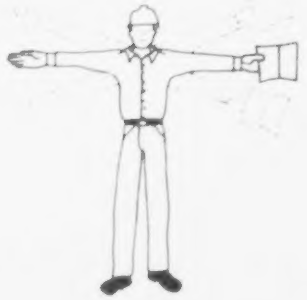


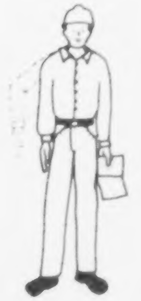


1. ____________________ 2. ____________________ 3. ____________________

K. Wrong face







1. ____________________ 2. ____________________ 3. ____________________

BUILDER'S LEVEL AND TRANSIT
UNIT V

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. 7.04′
B. 1′ – 10$\frac{3}{8}$″
C. 7.86′
D. 3′ – 11$\frac{1}{2}$″

Assignment Sheet #2

A. 2
B. 1
C. 3
D. 1,3
E. 2
F. 3
G. 1
H. 2
I. 3
J. 2
K. 1

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

BUILDER'S LEVEL AND TRANSIT
UNIT V

JOB SHEET #1 — SET UP AND ADJUST A BUILDER'S LEVEL

I. Equipment

A. Builder's level in carrying case

B. Tripod

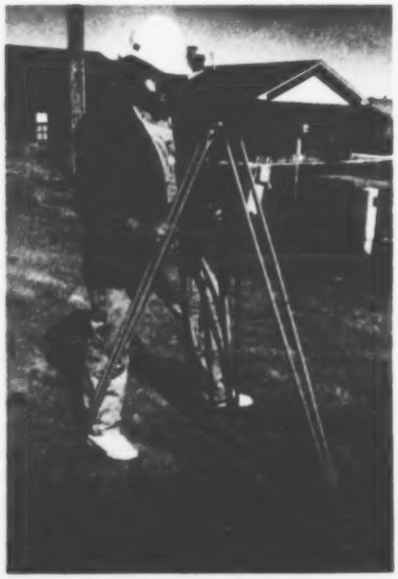
II. Procedure

A. Set leg shoes of the two nearest tripod legs in ground about 3 feet apart (See Figure 38)

B. Swing third leg out to form a triangle, placing legs on ground so that head plate is nearly level (Figure 38)

(NOTE: If the ground is not level, you may have to change position of tripod in order to keep head plate level. Always place two tripod legs on downhill or uneven side.)

FIGURE 38



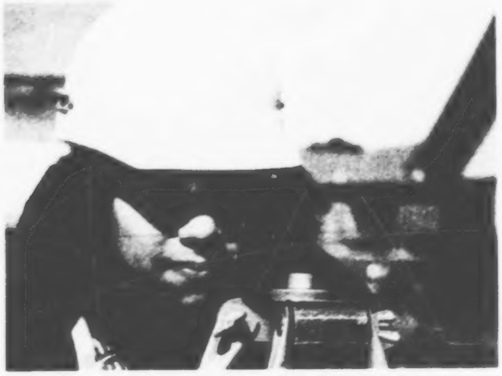
C. Tighten leg thumb-nuts

D. Remove head-plate cap and place cap in carrying case

JOB SHEET #1

E. Check head plate to assure that it is level (Figure 39)

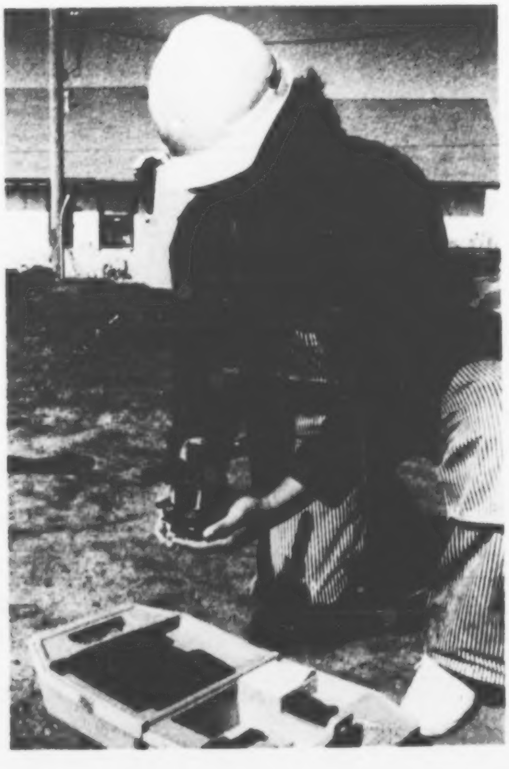
FIGURE 39



F. Remove instrument from carrying case by lifting level bar (Figure 40)

(NOTE: Never grasp the telescope barrel while removing instrument from carrying case.)

FIGURE 40

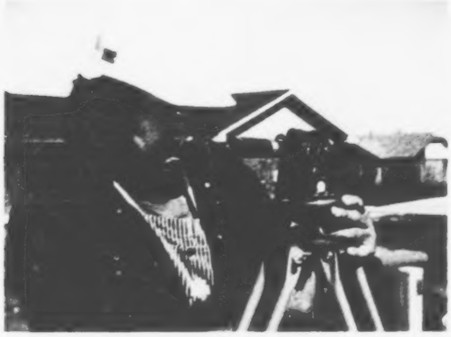


JOB SHEET #1

G. Attach instrument to tripod (Figure 41)

(NOTE: Keep a firm grip on instrument until it is securely in position on tripod.)

FIGURE 41



H. Remove dust cap from lens and place cap in carrying case

(NOTE: Between uses, keep the dust cap in place to protect the lens from dust or scratches.)

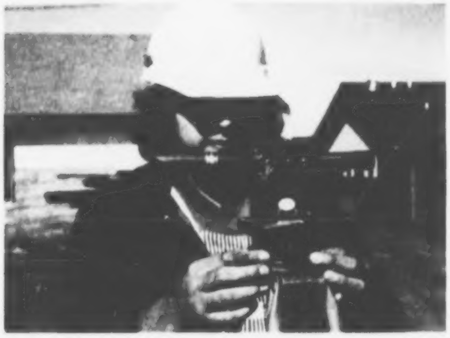
I. Attach sunshade to instrument if sunshade is not a permanent attachment

J. Align telescope barrel directly over one pair of leveling screws

(NOTE: The leveling screws will be used as the name indicates: to level the instrument.)

K. Rotate screws under leveling head by moving your thumbs in opposite directions until bubble is centered in leveling tube (Figure 42)

FIGURE 42

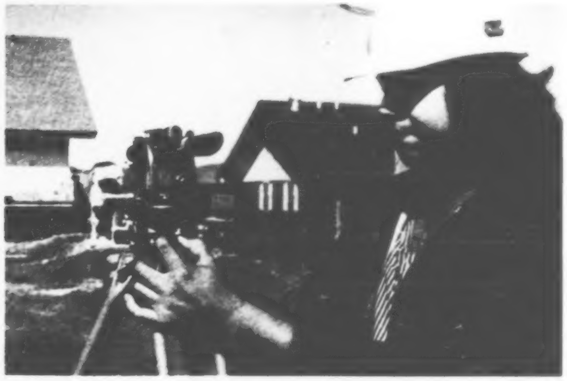


JOB SHEET #1

L. Turn instrument clockwise 90 degrees to align barrel over other pair of leveling screws

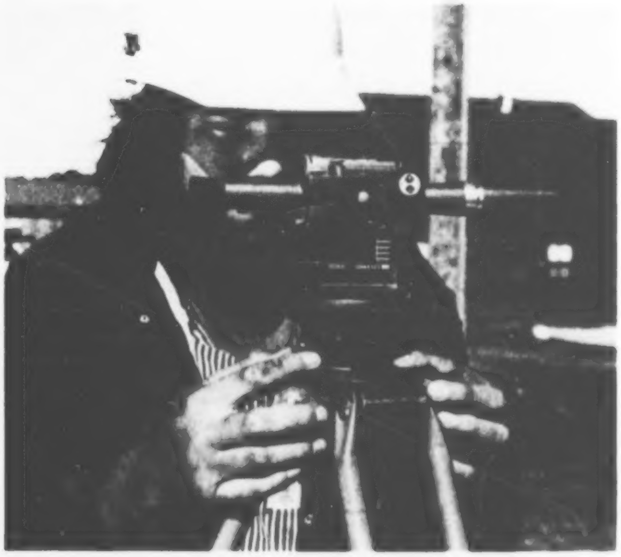
M. Rotate screws under leveling head by moving your thumbs in opposite directions until bubble is centered in leveling tube (Figure 43)

FIGURE 43



N. Turn instrument clockwise 90 degrees to bring it parallel with first pair of leveling screws; center bubble again (Figure 44)

FIGURE 44



O. Turn instrument clockwise 90 degrees to bring it parallel with second pair of leveling screws; center bubble again

(NOTE: Bubble should stay in center regardless of direction the telescope is pointing. If bubble does not stay in center, instrument is out of level and should be adjusted by competent personnel.)

JOB SHEET #1

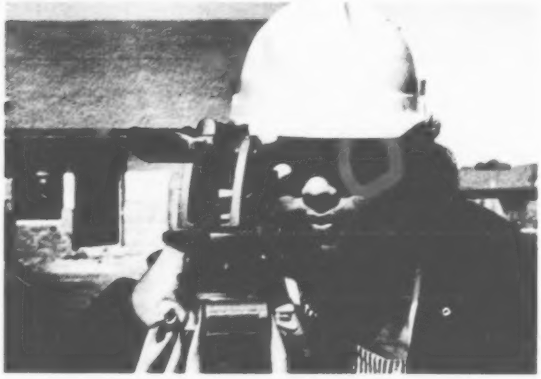
P. Avoid touching tripod after instrument is level

(NOTE: If instrument creeps off level or is bumped during use, stop and reset tripod, relevel instrument, and start again from last known good benchmark.)

Q. Turn eyepiece focusing ring until cross hairs appear clear and sharp (Figure 45)

(NOTE: The target may not be in focus.)

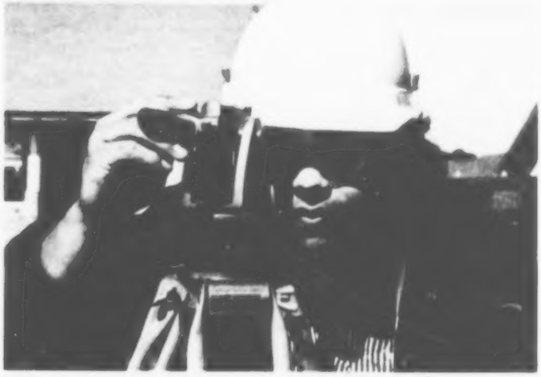
FIGURE 45



R. Rotate focusing screw to bring target into sharp focus (Figure 46)

(NOTE: When cross hairs and target are in sharp focus, you should be able to read a rod accurately. Always tie level shots back to starting benchmark to check for error in rod shots or in field notes.)

FIGURE 46



JOB SHEET #1

S. Disassemble instrument

1. Replace lens dust-cap
2. Remove instrument from tripod, holding instrument by its baseplate
3. Still holding instrument by its baseplate, replace instrument in carrying case
4. Replace head-plate cap on tripod

T. Store carrying case and tripod

BUILDER'S LEVEL AND TRANSIT
UNIT V

JOB SHEET #2 — CONNECT PLUMB BOB TO TRANSIT

I. Equipment

- A. Transit in carrying case
- B. Tripod
- C. Plumb bob with cord

II. Procedure

- A. Set leg shoes of the two nearest tripod legs in ground about 3 feet apart
- B. Swing third leg out to form a triangle, placing legs on ground so that head plate is nearly level

  (NOTE: If ground is not level, you may have to change position of tripod in order to keep head plate level. Always place two legs on downhill or uneven side.)

- C. Tighten leg thumb-nuts
- D. Check head plate to assure that it is level
- E. Remove transit from carrying case by lifting its baseplate

  (NOTE: Never grasp the telescope barrel while removing the transit from carrying case.)

- F. Still holding transit by its baseplate, attach transit to tripod
- G. Loop plumb-bob cord over hook on transit
- H. Knot cord
  1. Make first loop in cord (See Figure 47)

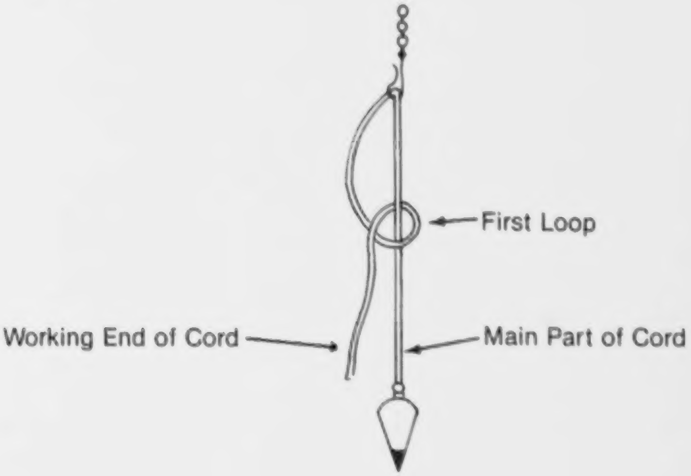
JOB SHEET #2

a. Bring working end of cord in front of main part of cord

b. Take working end behind main part of cord

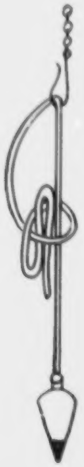
c. Draw working end through space between working end and main part of cord

FIGURE 47


First Loop
Working End of Cord
Main Part of Cord

2. Make a second loop in working end of cord (See Figure 48)
3. Pass second loop up through bottom of first loop (Figure 48)

FIGURE 48

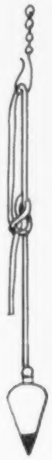


JOB SHEET #2

4. Tighten knot (Figure 49)

   (NOTE: This knot secures the plumb bob without affecting the true perpendicular. The knot can be easily untied to raise or lower the plumb bob.)

FIGURE 49



I. Disassemble transit from tripod, and replace instrument in carrying case

J. Store carrying case, tripod, and plumb bob

BUILDER'S LEVEL AND TRANSIT
UNIT V

JOB SHEET #3 — SET UP AND ADJUST A COMBINATION LEVEL-TRANSIT

I. Tools and equipment

A. Combination level-transit in carrying case

B. Tripod

C. Plumb bob with cord

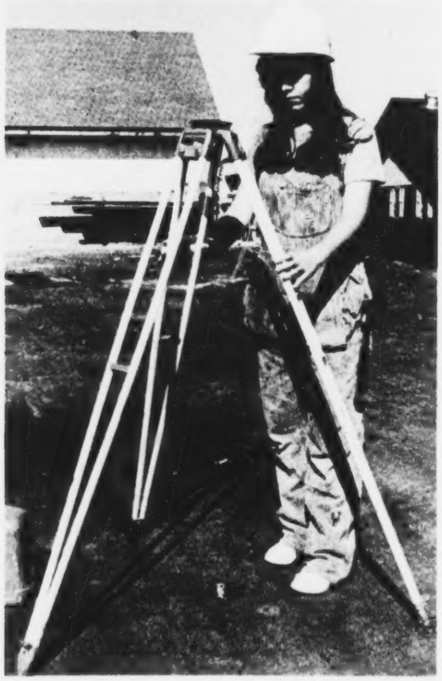
D. Stake driven in ground and marked with established point (provided by instructor)

II. Procedure

A. Over stake at point established by instructor, set leg shoes of the two nearest tripod legs in ground about 3 feet apart; swing third leg out to form a triangle, placing legs on ground so that head plate is nearly level (Figure 50)

(NOTE: If the ground is not level, you may have to change position of tripod in order to keep head plate level. Always place two tripod legs on downhill or uneven side.)

FIGURE 50

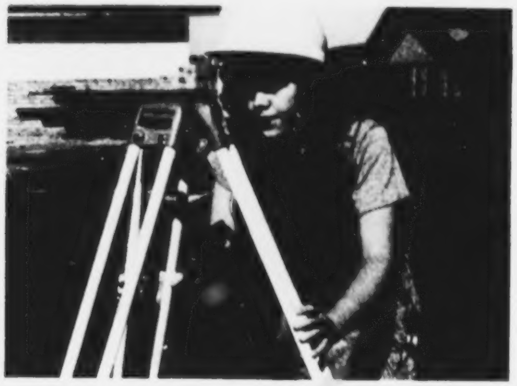


JOB SHEET #3

B. Tighten leg thumb-nuts

C. Check head plate to assure that it is level (Figure 51)

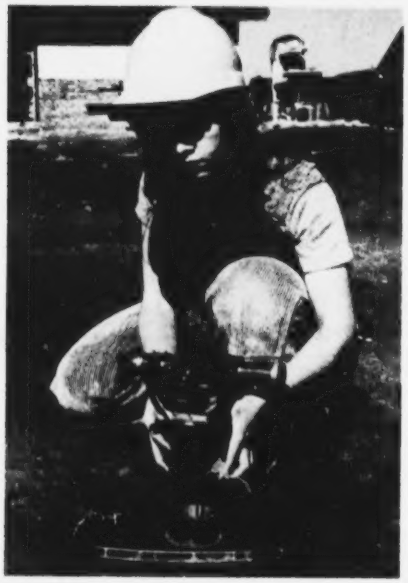
FIGURE 51



D. Remove instrument from carrying case by lifting its baseplate (Figure 52)

(NOTE: Never grasp the telescope barrel while removing the instrument from carrying case.)

FIGURE 52



E. Still holding instrument by its baseplate, attach instrument to tripod

F. Remove dust cap from lens and place cap in carrying case

JOB SHEET #3

G. Attach sunshade to instrument

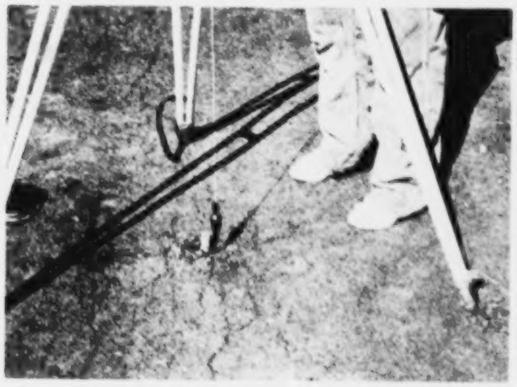
H. Attach plumb bob to instrument

(NOTE: Follow procedure in Job Sheet #2.)

I. Center instrument on footplate

J. Bring plumb bob to a position within 2 or 3 inches of established point on stake, moving tripod and instrument together (Figure 53)

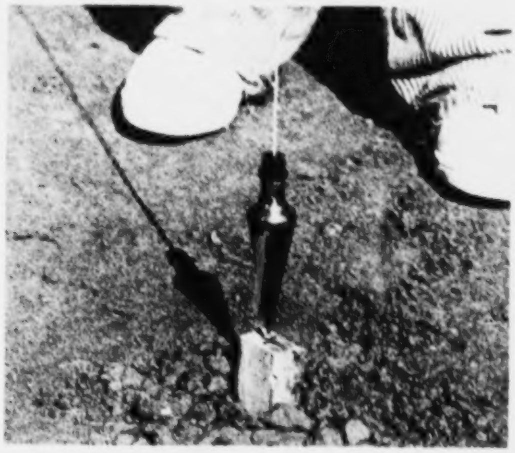
FIGURE 53



K. Firmly set tripod legs into ground

L. Raise or lower plumb bob until it hangs about 1 inch above established point on stake (Figure 54)

FIGURE 54

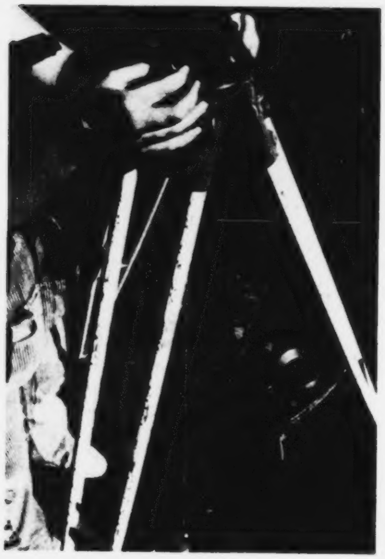


JOB SHEET #3

M. Moving tripod legs from side to side, adjust legs as required to bring plumb bob within 1/4 inch of established point on stake

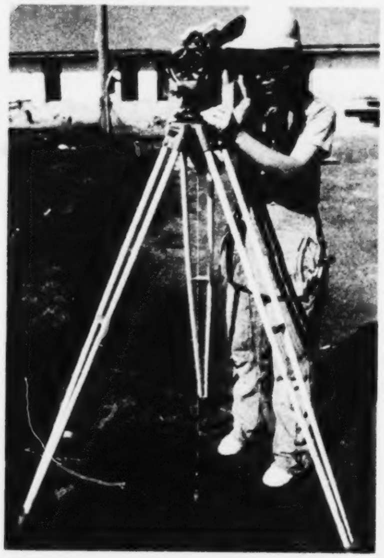
N. Loosen one pair of leveling screws (Figure 55)

FIGURE 55



O. Slide leveling head until plumb bob and the center of the small ellipse in which plumb bob swings are exactly over established point on stake (Figure 56)

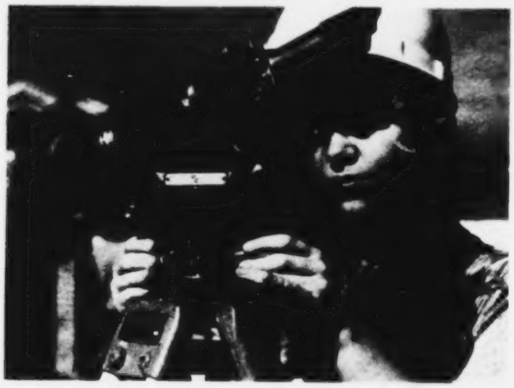
FIGURE 56



JOB SHEET #3

P. Tighten leveling screws firmly (Figure 57)

FIGURE 57



Q. Level instrument

(NOTE: Follow procedure as for builder's level in steps J through R of Job Sheet #1.)

R. Disassemble instrument

1. Replace lens dust-cap
2. Remove instrument from tripod, holding instrument by its baseplate
3. Still holding instrument by its baseplate, replace instrument in carrying case

S. Store carrying case, tripod, and other tools and equipment

BUILDER'S LEVEL AND TRANSIT
UNIT V

JOB SHEET #4 — USE A COMBINATION LEVEL-TRANSIT TO LOCATE BUILDING-LINE POINTS ON BATTER BOARDS

I. Tools and equipment

A. Combination level-transit in carrying case

B. Tripod

C. Plumb bob with cord

D. 200-foot tape

E. Claw hammer

F. Stakes

G. Sledgehammer

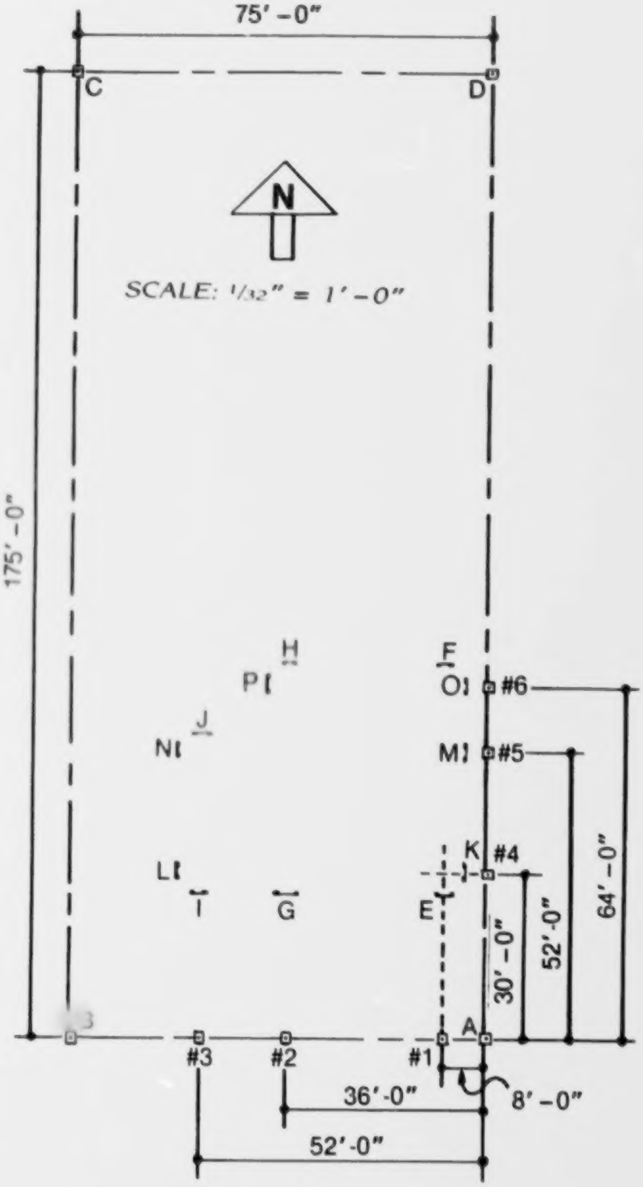
H. Surveyor's tacks

I. Nails

J. Batter-board layout (Figure 58)

(NOTE: The angle formed by lines AB and AD is a 90-degree angle.)

FIGURE 58


75'-0"
C
D
N
SCALE: 1/32" = 1'-0"
175'-0"
H
P
F
O
#6
J
N
M
#5
K
#4
L
I
G
E
64'-0"
52'-0"
30'-0"
B
A
#3
#2
#1
36'-0"
8'-0"
52'-0"

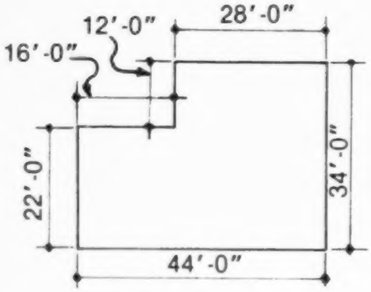
JOB SHEET #4

II. Procedure

A. Study batter-board layout (See Figure 58) and building dimensions (Figure 59)

(NOTE: The instructor has established property-line points A, B, C, and D and has marked these points on lot with stakes and surveyor's tacks; instructor has also determined that the angle formed by lines AB and AD is a 90-degree angle. The instructor has also set batter boards for a building on a 75′ –0″ × 175′ –0″ lot. The building is set back 30 feet from south boundary and 8 feet from east boundary.)

FIGURE 59



B. Check tacks on property-line stakes to make certain that line AB is straight

1. Set up and adjust level-transit over point A

   (NOTE: See Job Sheet #3.)

2. Loosen vertical-motion clamp screws

3. Tilt instrument downward, and sight through telescope at tack on point B

4. Focus instrument on tack on stake at point B to determine whether line AB is straight

   (NOTE: If line AB is not straight, notify the instructor.)

5. Tighten vertical-motion clamp screws

   (NOTE: Do not overtighten screws.)

C. Check tacks on property-line stakes to make certain that line AD is straight

1. With instrument still focused on point B, set the 360-degree scale at zero

JOB SHEET #4

2. Loosen horizontal-motion clamp screws, and turn instrument clockwise until the scale indicates that a 90-degree arc has been completed

   (NOTE: The instrument should now be at line AD.)

3. Tighten horizontal-motion clamp screws

   (NOTE: Do not overtighten screws.)

4. Use tangent screw to make final 90-degree adjustments

5. Loosen vertical-motion clamp screws, and adjust tilt of instrument to sight at point D

6. Focus instrument on tack on stake at point D to determine whether line AD is straight

   (NOTE: If line AD is not straight, notify the instructor.)

7. Tighten vertical-motion clamp screws

D. Establish setup locations #1, #2, and #3 along line AB

   1. Beginning at point A, use tape to measure along line AB to establish locations at distances of 8 feet, 36 feet, and 52 feet (See Figure 65)

      (NOTE: Do not disturb level-transit.)

   2. Drive a stake at each location

   3. Set a tack in top of each stake at exact measured distance from point A

E. Establish setup locations #4, #5, and #6 along line AD

   1. Beginning at point A, use tape to measure along line AD to establish locations at distances of 30 feet, 52 feet, and 64 feet (See Figure 65)

      (NOTE: Do not disturb level-transit.)

   2. Drive a stake at each location

   3. Set a tack in top of each stake at exact measured distance from point A

F. Check tacks on setup stakes #4, #5, and #6 along line AD to make sure that they are in a straight line

   1. With instrument still sighted on tack on stake at point D, focus instrument and take a reading to determine whether tacks on stakes #4, #5, and #6 along line AD are in a straight line

   2. Have assistant adjust tacks on stakes as necessary

JOB SHEET #4

G. Check tacks on setup #1, #2, and #3 along line AB to make sure that they are in a straight line

1. With instrument still focused on point D, set the 360-degree scale at zero
2. Loosen horizontal-motion clamp screws, and turn instrument clockwise until the scale indicates that a 90-degree arc has been completed

   (NOTE: Level-transit should now be at line AB.)
3. Tighten horizontal-motion clamp screws

   (NOTE: Do not overtighten screws.)
4. Use tangent screw to make final 90-degree adjustments
5. Loosen vertical-motion clamp screws, and adjust tilt of instrument to sight at point B
6. Focus instrument and take a reading to determine whether tacks on setup stakes #1, #2, and #3 along line AB are straight
7. Have assistant adjust tacks as necessary
8. Tighten vertical-motion clamp screws

   (NOTE: Do not overtighten screws.)

H. Locate building-line points E and F on batter boards

1. Set up and adjust level-transit over stake #1 at 8-foot location on line AB

   (NOTE: See Job Sheet #3.)
2. Loosen vertical-motion clamp screws
3. While assistant holds a nail on batter board, tilt instrument and sight through telescope to determine correct location for point E
4. Have assistant adjust location of nail as necessary until correct location is established
5. Have assistant drive nail into batter board at exact location established
6. While assistant holds a nail on batter board, sight through telescope to determine correct location for point F
7. Have assistant adjust location of nail as necessary until correct location is established

JOB SHEET #4

8. Have assistant drive nail into batter board at exact location established

9. Tighten vertical-motion clamp screws

   (NOTE: Do not overtighten screws.)

I. Locate building-line points G and H on batter boards

1. Set up and adjust level-transit over stake #2 at 36-foot location on line AB

   (NOTE: See Job Sheet #3.)

2. Loosen vertical-motion clamp screws

3. While assistant holds a nail on batter board, tilt instrument and sight through telescope to determine correct location for point G

4. Have assistant adjust location of nail as necessary until correct location is established

5. Have assistant drive nail into batter board at exact location established

6. While assistant holds a nail on batter board, sight through telescope to determine correct location for point H

7. Have assistant adjust location of nail as necessary until correct location is established

8. Have assistant drive nail into batter board at exact location established

9. Tighten vertical-motion clamp screws

   (NOTE: *Do not* overtighten screws.)

J. Locate building-line points I and J on batter boards

1. Set up and adjust level-transit over stake #3 at 52-foot location on line AB

   (NOTE: See Job Sheet #3.)

2. Loosen vertical-motion clamp screws

3. While assistant holds a nail on batter board, tilt instrument and sight through telescope to determine correct location for point I

4. Have assistant adjust location of nail as necessary until correct location is established

5. Have assistant drive nail into batter board at exact location established

JOB SHEET #4

6. While assistant holds a nail on batter board, sight through telescope to determine correct location for point J

7. Have assistant adjust location of nail as necessary until correct location is established

8. Have assistant drive nail into batter board at exact location established

9. Tighten vertical-motion clamp screws

   (NOTE: Do not overtighten screws.)

K. Using procedure described above, set up level-transit over stake #4 at 30-foot location on line AD, and locate building-line points K and L on batter boards

L. Using procedure described above, set up level-transit over stake #5 at 52-foot location on line AD, and locate building-line points M and N on batter boards

M. Using procedure described above, set up level-transit over stake #6 at 64-foot location on line AD, and locate building-line points O and P on batter boards

N. Disassemble instrument

   1. Replace lens dust-cap

   2. Remove instrument from tripod, holding instrument by its baseplate

   3. Still holding instrument by its baseplate, replace instrument in carrying case

O. Store carrying case, tripod, and other tools and equipment

BUILDER'S LEVEL AND TRANSIT
UNIT V

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with leveling instruments. Write the correct numbers in the blanks.

______a. Rod used with leveling instrument; graduated in tenths and hundredths of a foot or in inches and feet

______b. Vertical distance from benchmark to line of sight of leveling instrument

______c. Automatic level that uses a laser beam to establish elevation readings

______d. Leveling instrument consisting of a telescope and leveling bubble; used with a tripod and leveling rod primarily for establishing grade levels

______e. Tool or device attached to a string; used to set and check the vertical or perpendicular of a surface

______f. Very precise leveling instrument used to establish straight lines and to measure horizontal and vertical angles

______g. Fine horizontal and vertical lines in telescope of leveling instrument; used as reference lines in the field or for marking instrumental axis

______h. Line from an observer's eye to a distant point toward which he or she is directing a leveling instrument

______i. System of lines or cross hairs in the focus of the eyepiece of an optical instrument

______j. Leveling method by which the difference in elevation between two points is determined by plus and minus rod readings that are totaled and adjusted to benchmark

1. Height of instrument (HI)
2. Laser-beam instrument
3. Plumb bob
4. Leveling rod
5. Builder's level
6. Differential leveling
7. Cross hairs
8. Line of sight
9. Transit
10. Reticle

TEST

2. Match to their correct definitions terms associated with surveying. Write the correct numbers in the blanks.

______a. Elevation reference point used when the permanent point is not in sight

______b. Given grade

______c. Elevation of finished floor in relation to benchmark

______d. Permanent point of known or assumed elevation

______e. Proposed or future level of ground at construction line

______f. Small book used to record instrument readings for layout and elevations of proposed structures

______g. Difference between elevations of two points on a slope

______h. Plot of ground on which a project is to be constructed

______i. Art or science of determining area and configuration of portions of the earth's surface with a maximum of accuracy

______j. Surveying method for determining distances and differences of elevation through means of a transit and rod

______k. Bearing relative to magnetic north

______l. Stake driven into ground, usually with top establishing finished level of ground or concrete at that point

1. Elevation
2. Grade line
3. Finish-floor height
4. Benchmark (BM)
5. Temporary benchmark (TBM)
6. Field book
7. Fall
8. Site
9. Surveying
10. Grade stake
11. Stadia
12. Magnetic bearing

3. Explain *stadia reticle*.

____

____

____

4. List uses of a level.

a. ______________________________

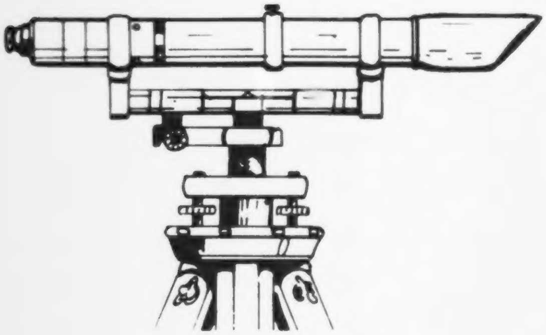
b. ______________________________

c. ______________________________

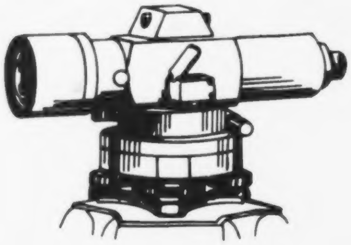
TEST

5. Identify the following illustrations of types of levels. Write the correct names in the blanks. Illustrations continue on the next page.

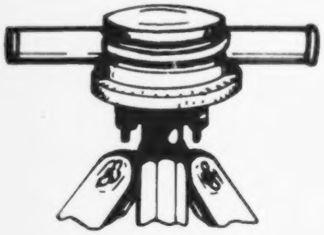
Builder's level
Turret level
Engineer's Zeiss level
Laser-beam instrument
Engineer's wild-tilting level
Automatic level
Engineer's dumpy level



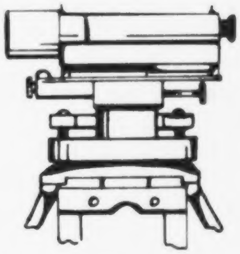
a. ______________________________



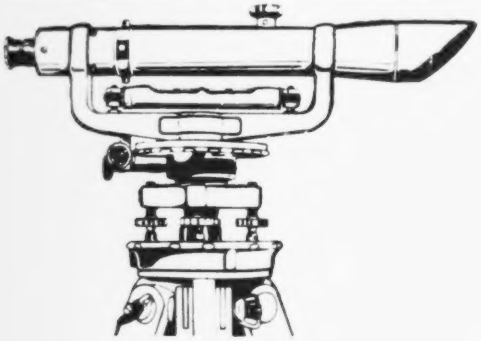
b. ______________________________



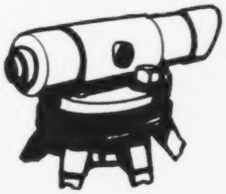
c. ______________________________



d. ______________________________

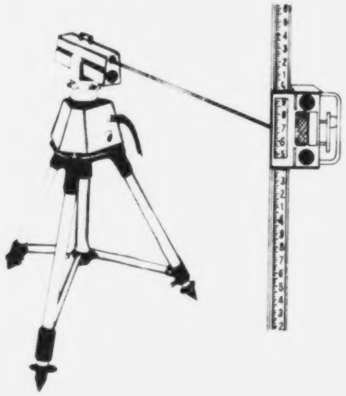


e. ______________________________



f. ______________________________

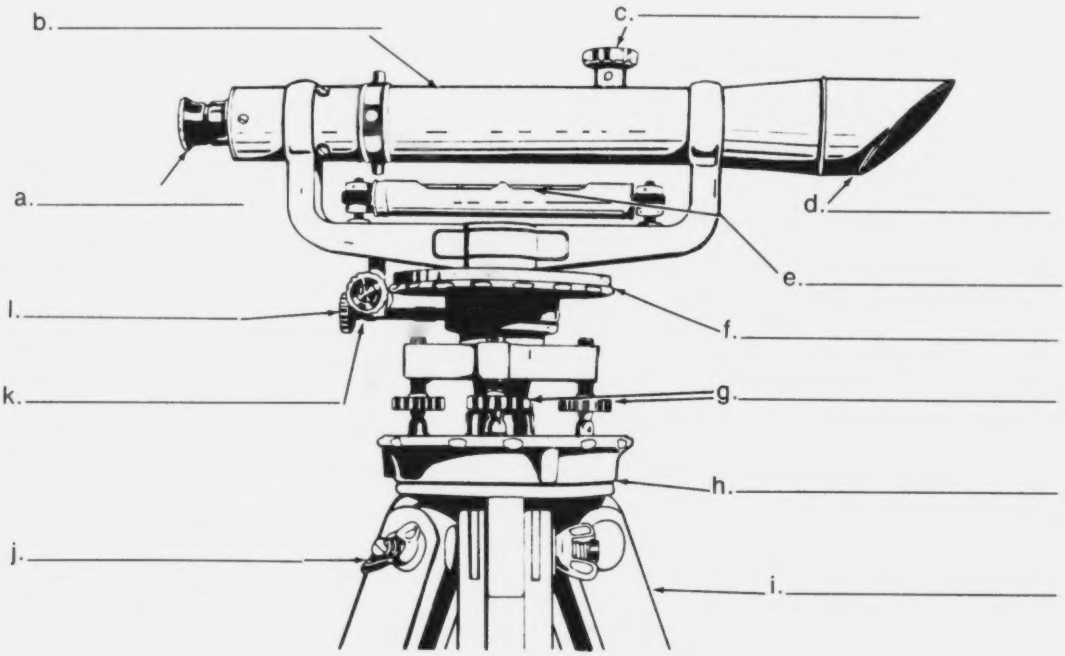
TEST



g. ______________________________

6. Identify the parts of the builder's level illustrated below. Write the correct names in the blanks.

Telescope
Slow-motion screw
Leveling screws
Leg thumb-nut
Leveling tube
Eyepiece
Sunshade
Degree scale
Focusing screw
Tripod
Clamp
Head plate


b. ______________________
c. ______________________
a. ______________
d. ______________________
e. ______________________
l. ______________________
f. ______________________
k. ______________________
g. ______________________
h. ______________________
j. ______________________
i. ______________________

TEST

7. List four uses of a transit.

a. ______________________________

b. ______________________________

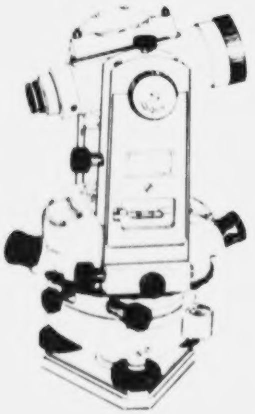
c. ______________________________

d. ______________________________

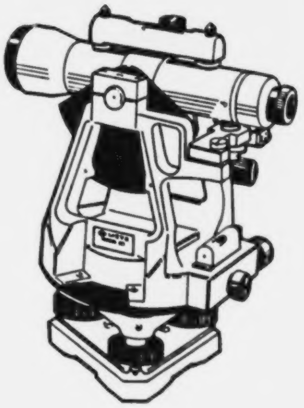
8. Identify the types of transits illustrated below. Write the correct names in the blanks.

Optical transit
Engineer's transit

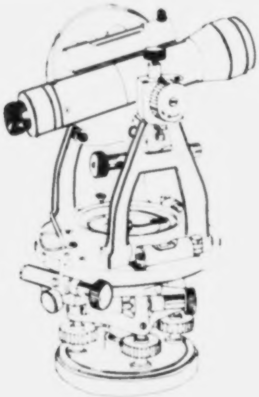
Optical plummet transit
Combination level-transit



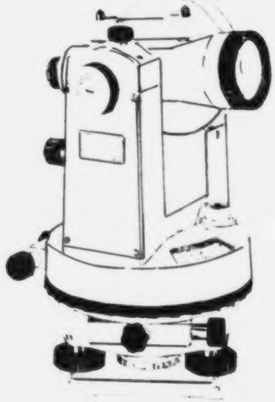
a. ______________________________



b. ______________________________



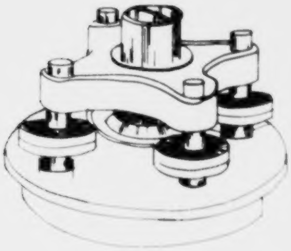
c. ______________________________

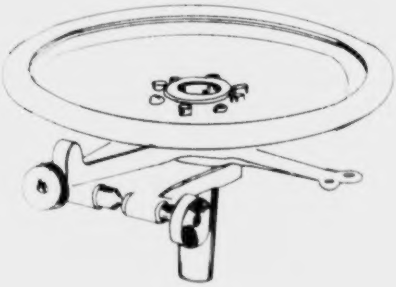


d. ______________________________

TEST

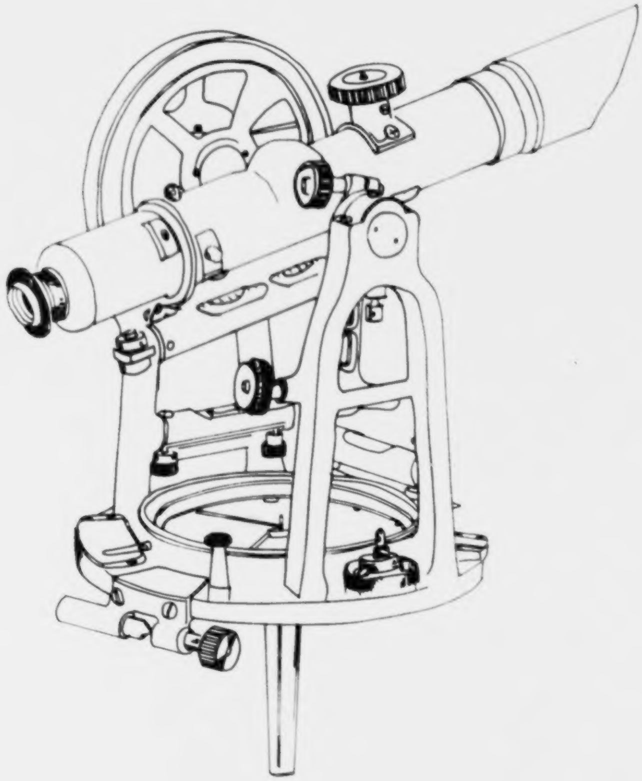
9. Label the major components of an engineer's transit. Write the correct names in the blanks.





a. ______________________

b. ______________________



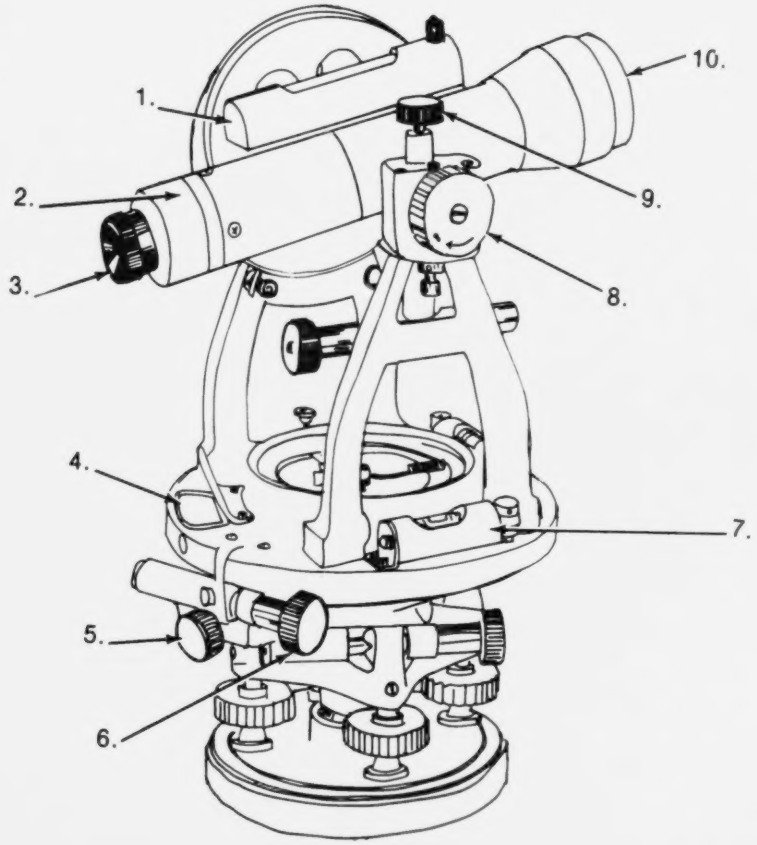
c. ______________________

TEST

10. Identify the parts of the engineer's transit illustrated in the following views. Write the correct names in the blanks. View b is on the next page.

Upper-motion tangent screw
Telescope level vial
Eyepiece
Telescope clamp screw
Telescope focusing pinion
Telescope
Objective lens
Upper-motion clamp screw
Plate level vial
Horizontal circle and vernier

View a

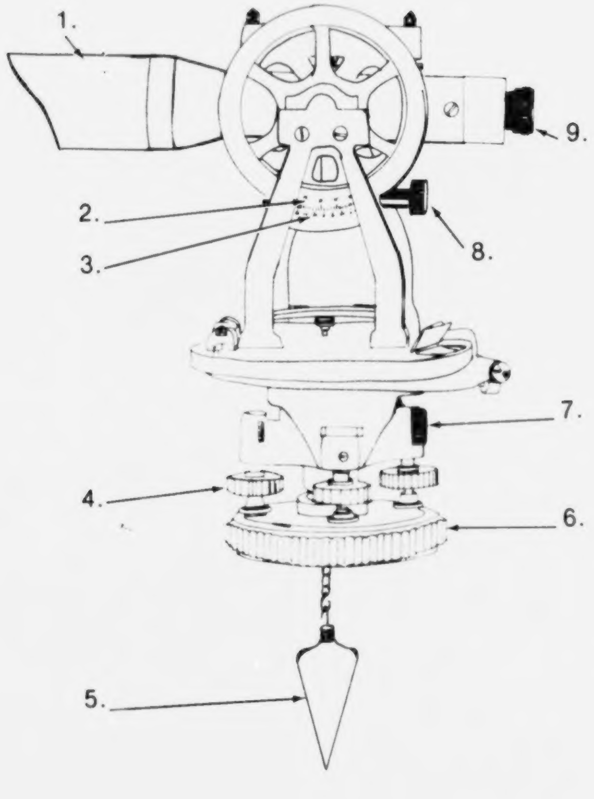


1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________

TEST

Vertical vernier
Sunshade
Baseplate
Lower-motion tangent screw
Vertical circle
Leveling screw
Plumb bob
Focusing ring
Telescope tangent screw

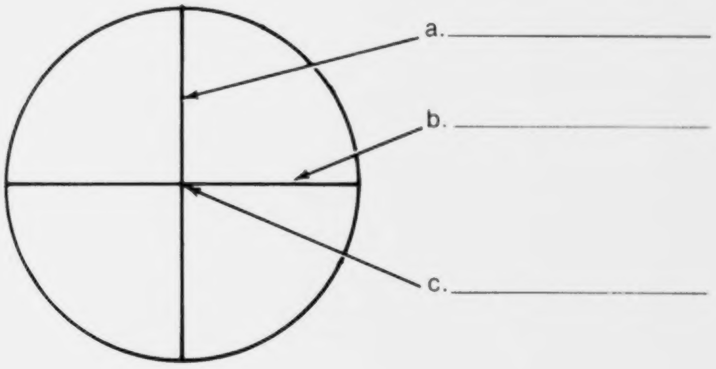
View b



1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________

TEST

11. Label vertical and horizontal cross hairs and line of sight on the leveling instrument illustrated below.



12. State five rules for proper care of leveling instruments.

a. ____

b. ____

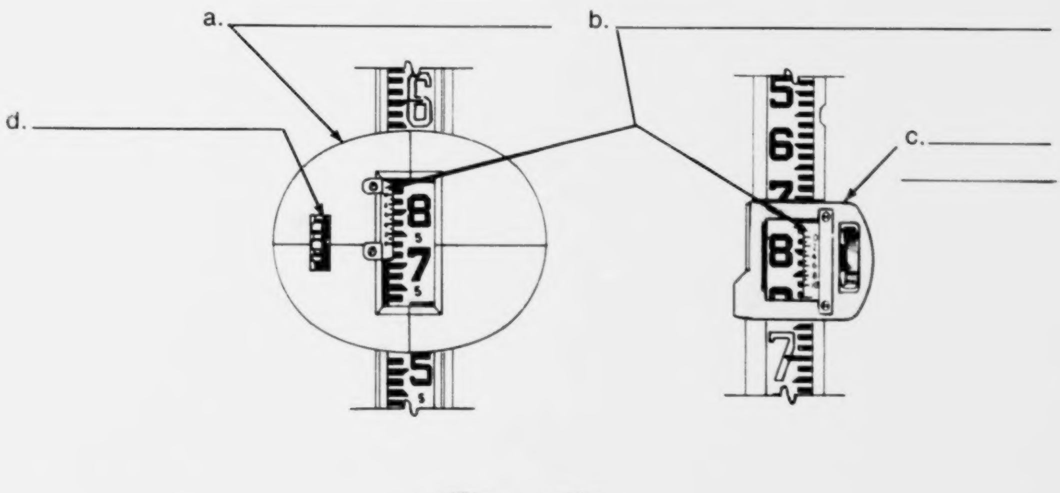
c. ____

d. ____

e. ____

13. Identify the parts of the leveling rod illustrated below. Write the correct names in the blanks.

Rod clamp **Target clamp** **Vernier scale** **Target**



TEST

14. Match parts of a leveling rod to their correct uses. Write the correct numbers in the blanks.

_____a. Holds target in place

_____b. Holds rod open when extended

_____c. Helps make measurements within a certain range on leveling rod; holds vernier scale

_____d. Enables reading to the nearest thousandth of a foot or nearest sixty-fourth of a foot

1. Target
2. Target clamp
3. Vernier scale
4. Rod clamp

15. Describe commonly used direct-reading rods.

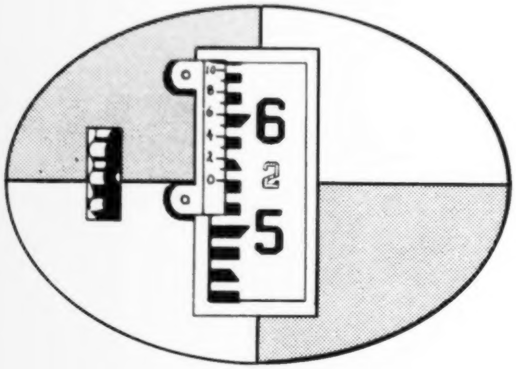
a. Rod graduated in eighths of an inch — ____________________________________

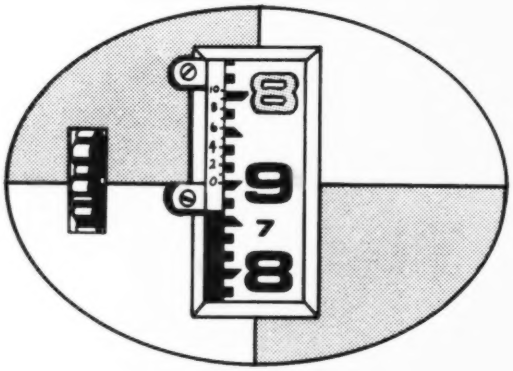
____

b. Rod graduated in hundredths of a foot — ____________________________________

____

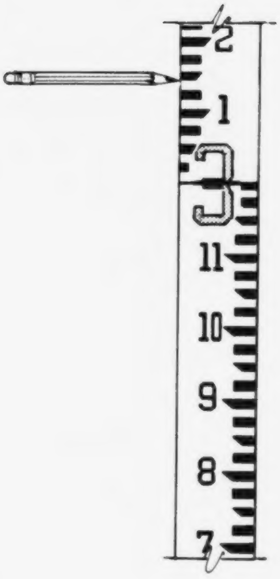
16. Read each of the following illustrations of direct-reading rods to the nearest hundredth or eighth. Write the correct answers in the blanks. Illustrations continue on the next page.

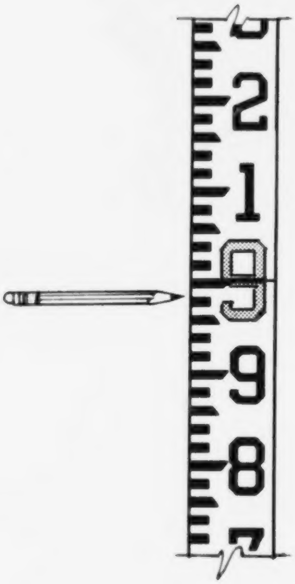




a. ______________________________ b. ______________________________

TEST

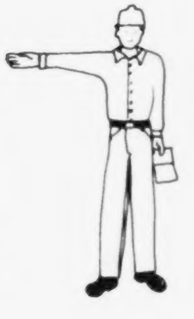


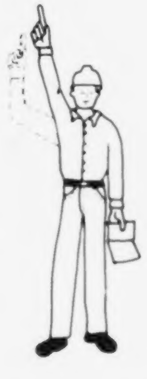


c. ________________________ d. ________________________

17. Identify hand signals used by the instrument person to guide the rod person. Write the correct names in the blanks. Some blanks may contain more than one answer. Some answers may be used more than once. Illustrations continue on the next two pages.

Observation completed
Turning point
Move down
Check clamp
Rod upside down
Move in this direction
Wave rod from side to side
Move on
Understand
Move up
Wrong face
Use long rod
Come in

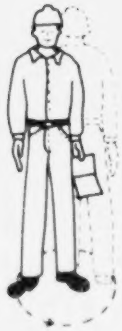




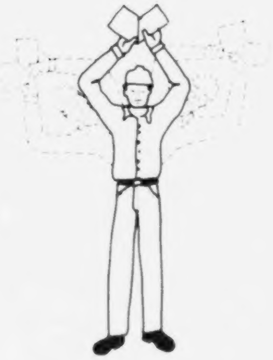
a. ________________________ b. ________________________

________________________ ________________________

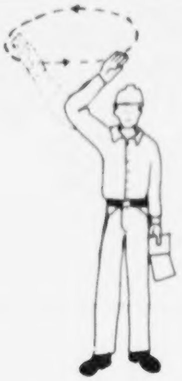
TEST



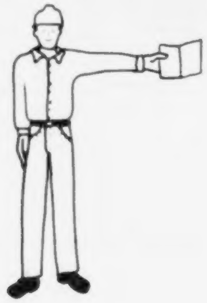
c.



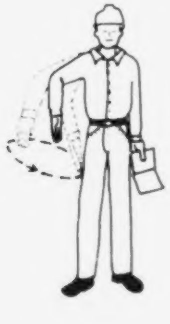
d.



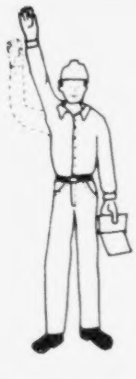
e.



f.

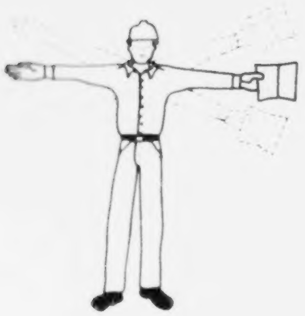


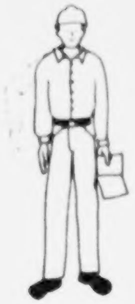
g.



h.

TEST





i. ______________________________

____

j. ______________________________

____

(NOTE: Test question 18 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

18. Demonstrate the ability to

    a. Set up and adjust a builder's level.

    b. Connect plumb bob to transit.

    c. Set up and adjust a combination level-transit.

    d. Use a combination level-transit to locate building-line points on batter boards.

BUILDER'S LEVEL AND TRANSIT
UNIT V

ANSWERS TO TEST

1. a. 4
   b. 1
   c. 2
   d. 5
   e. 3
   f. 9
   g. 7
   h. 8
   i. 10
   j. 6

2. a. 5
   b. 1
   c. 3
   d. 4
   e. 2
   f. 6
   g. 7
   h. 8
   i. 9
   j. 11
   k. 12
   l. 10

3. Explanation should include the following

   Additional horizontal lines in the telescope eyepiece that are used to determine distance between leveling rod and plumb bob

4. a. Establishing elevations and grades
   b. Establishing differential elevations
   c. Transferring elevations from one point to another

5. a. Engineer's dumpy level
   b. Automatic level
   c. Turret level
   d. Engineer's wild-tilting level
   e. Builder's level
   f. Engineer's Zeiss level
   g. Laser-beam instrument

6. a. Eyepiece
   b. Telescope
   c. Focusing screw
   d. Sunshade
   e. Leveling tube
   f. Degree scale
   g. Leveling screws
   h. Head plate
   i. Tripod
   j. Leg thumb-nut
   k. Slow-motion screw
   l. Clamp

7. Answer should include any four of the following

   a. Measuring horizontal angles
   b. Measuring vertical angles
   c. Measuring elevations
   d. Measuring horizontal and vertical distances

ANSWERS TO TEST

e. Determining magnetic bearings
f. Laying out boundaries and building lines
g. Establishing elevations and grades

8. a. Optical transit
b. Combination level-transit
c. Engineer's transit
d. Optical plummet transit

9. a. Leveling head
b. Horizontal circle
c. Alidade

10. **View a**
1. Telescope level vial
2. Telescope
3. Eyepiece
4. Horizontal circle and vernier
5. Upper-motion clamp screw
6. Upper-motion tangent screw
7. Plate level vial
8. Telescope focusing pinion
9. Telescope clamp screw
10. Objective lens

View b
1. Sunshade
2. Vertical circle
3. Vertical vernier
4. Leveling screw
5. Plumb bob
6. Baseplate
7. Lower-motion tangent screw
8. Telescope tangent screw
9. Focusing ring

11. a. Vertical cross hair
b. Horizontal cross hair
c. Line of sight

12. Answer should include any five of the following

a. Keep instrument in carrying case when not in use
b. Protect instrument from shock and vibration when transporting
c. Remove instrument from carrying case by lifting the level bar or baseplate
d. Never force screws or other moving parts of the instrument
e. Place lens and tripod caps in carrying case after removing them from instrument
f. Do not remove lenses
g. Clean lenses with soft tissue only
h. Always use sunshade regardless of weather
i. Loosen leveling screws before returning instrument to carrying case
j. Carry tripod under your arm with the instrument in front of you

ANSWERS TO TEST

13. a. Target
    b. Vernier scale
    c. Rod clamp
    d. Target clamp

14. a. 2 c. 1
    b. 4 d. 3

15. Description should include the following

    a. Rod graduated in eighths of an inch—Marks indicate feet, inches, and eighths of an inch; each line and each space is one-eighth of an inch thick
    b. Rod graduated in hundredths of a foot—Marks indicate feet, tenths of a foot, and hundredths of a foot; each line and each space is one hundredth of a foot thick

16. a. 2.54′
    b. 7.90′
    c. 3′ – 1$\frac{3}{8}$″
    d. 8.98′

17. a. Move in this direction
    b. Move up
    c. Wrong face; check clamp; rod upside down
    d. Wave rod from side to side
    e. Turning point
    f. Move in this direction
    g. Come in
    h. Use long rod
    i. Observation completed; move on; understand
    j. Move down

18. Performance skills evaluated to the satisfaction of the instructor

SITE LAYOUT
UNIT VI

UNIT OBJECTIVE

After completing this unit, the student should be able to erect batter boards, locate building lines, lay out footings, square building lines, and set grade stakes. The student will show this knowledge by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with site layout.
2. Match to their correct definitions terms pertaining to grades and leveling instruments.
3. Name factors pertinent to site layout.
4. Select from a list information used to lay out building lines.
5. State the purpose of batter boards.
6. Describe common methods used to square building lines.
7. Demonstrate the ability to
    a. Erect batter boards and locate building lines for a structure.
    b. Lay out footings for a structure.
    c. Set grade stakes for footings without forms.

SITE LAYOUT
UNIT VI

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Information sheet

  D. Assignment Sheet #1 — Write Layout Dimensions on a Plot Plan

  E. Answers to assignment sheet

  F. Job sheets

    1. Job Sheet #1 — Erect Batter Boards and Locate Building Lines for a Structure

    2. Job Sheet #2 — Lay Out Footings for a Structure

    3. Job Sheet #3 — Set Grade Stakes for Footings Without Forms

  G. Test

  H. Answers to test

II. Instructor's guide

  A. Obtain materials to supplement unit.

    1. Set of local regulations, covenants, and zoning laws

    2. Appropriate site-layout instrument or combination transit and rod

    3. Equipment and materials necessary for students to complete job sheets

    4. Copies of various plot plans

    5. Competency profiles

    (NOTE: Competency profiles for this series are available from The Associated General Contractors of America, 1957 E Street N.W., Washington, D. C. 20006, or from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364.)

  B. Introduce unit to students.

- Review "Measuring" and "Basic Plan Reading," Units III and IV, Section B.
- Review "Builder's Level and Transit," Unit V, Section B.

SUGGESTED ACTIVITIES

- Emphasize to students the importance of knowing local regulations, covenants, restrictions, and zoning laws. Explain how knowing the laws and regulations could save them time, money, and possible lawsuits.
- Point out that accuracy is essential in site layout: The cost of redoing or making architectural changes may be prohibitive or unacceptable.
- Liken site layout to a journey. The first step may mean the difference between a successful journey and being lost.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information, assignment, and job sheets.

F. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with site layout.
    - Explain that an understanding of terms related to site layout is essential for reading and understanding plans and covenants.
    - Explain that commonality of term meanings is required for communication with workers within the trade and with workers from related trades employed on the job site.
2. Use Information Sheet, Section II, to discuss terms and definitions pertaining to grades and leveling instruments.
    - Take students on a field trip to a construction site on which workers are laying out a building.
    - Have an open quiz by asking for the definition of each term or by giving the definition and asking for the appropriate term.
    - Show students examples of appropriate terms.
3. Use Information Sheet, Section III, to discuss factors pertinent to site layout.
    - Hand out copies of local regulations and covenants for a construction project. Have students read covenants and locate particulars. Discuss in class and answer questions as they arise.
    - Invite a utility company representative to discuss locating utilities and to relate case studies of problems that have been encountered.
4. Use Information Sheet, Section IV, to discuss information used to lay out building lines.
    - Provide students with various plot plans to illustrate information related to laying out building lines.

SUGGESTED ACTIVITIES

- Have students practice recognizing layout dimensions on a plot plan by having them complete Assignment Sheet #1.

5. Use Information Sheet, Section V, to discuss the purpose of batter boards.

    - Demonstrate procedures and have students erect batter boards as outlined in part II C of Job Sheet #1.

6. Use Information Sheet, Section VI, to discuss methods used to square building lines.

    - Have students use stakes and strings to practice squaring corners. In inclement weather, have students practice inside with chalk and string.
    - Demonstrate procedures and have students complete part II D of Job Sheet #1.
    - Set up a contest to see who can correctly lay out building lines, maintain square, and shoot correct grades most quickly or efficiently.
    - Demonstrate procedures and have students complete Job Sheets #2 and #3.
    - Point out that the scales shown on the plot plan, foundation plan, and the floor plan are no longer accurate. The scales are the original ones used in making the drawings, but the plans have been reduced.

G. Review information.

H. Give test.

I. Critique test and discuss in class.

J. Complete appropriate section of competency profiles.

III. Unit reference

Hendrix, Laborn J. "Bud". *Fundamentals of Carpentry*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1985.

SITE LAYOUT
UNIT VI

INFORMATION SHEET

I. Terms and definitions associated with site layout

A. **Batter board** — Temporary framework on which to stretch a line to assist in locating corners and building lines when laying out a building (Figures 1 and 2)

EXAMPLES:

FIGURE 1: Straight batter board

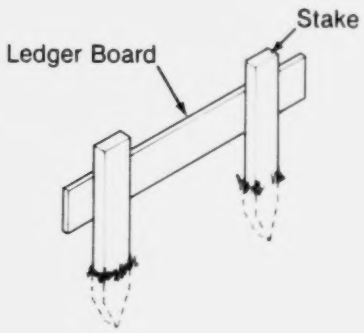
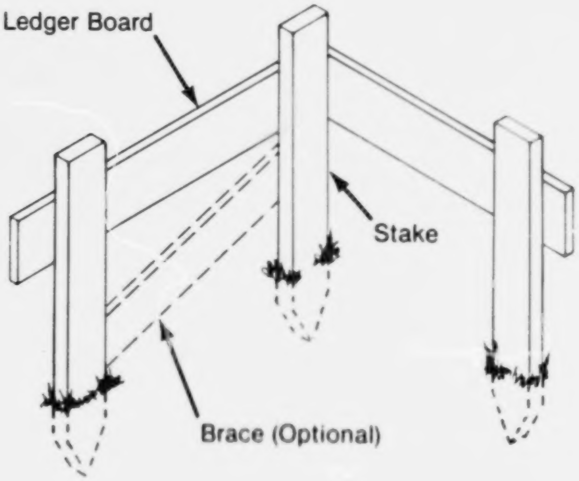

Stake
Ledger Board

FIGURE 2: Right-angle batter board


Ledger Board
Stake
Brace (Optional)

INFORMATION SHEET

B. **Building permit** — Agreement between builder and city that specifies the type, quality, and extent of construction on structure to be erected

C. **Easement** — A vested or acquired right to use land, other than as a tenant, for a specific purpose; such right being held by someone other than the owner who holds the title to the land

D. **Excavating** — Removing soil for footing or for establishing a uniform grade

E. **Kerf** — Slight indentation made with a saw; used to hold line in place

F. **Ledger board** — Top horizontal board on batter-board framework

G. **Plot plan** — Drawing used to show location and size of structure(s), driveways, sidewalks, patios, property lines, utilities, and existing conditions

H. **Plumb bob** — Tool or device attached to a string; used to set or check plumb or perpendicular of a surface

I. **Plumb down** — To plumb from a given point down to a point below

J. **Property lines** — Boundaries of a lot or plot of ground

K. **Setback line** — Line established by law, fixing exterior face of structure a minimum distance from right-of-way or property line

L. **Surveying** — Art or science of determining the area and configuration of portions of the earth's surface

II. Terms and definitions pertaining to grades and leveling instruments

A. **Benchmark (BM)** — Permanent point of known or assumed elevation

(NOTE: A specific point on a curb, culvert, or other permanent object is sometimes used.)

B. **Builder's level** — Instrument consisting of a telescope, leveling bubble, and tripod; used primarily for establishing grade levels

C. **Elevation** — Given grade

D. **Fall** — The slope of a line, usually expressed as inches per foot of run

EXAMPLE: 1 inch fall per 1 foot of run

E. **Fill** — Soil or other substance used to raise grade level

F. **Finish-floor grade** — Elevation of finished floor in relation to benchmark

INFORMATION SHEET

G. **Grade line** — Proposed or future level of ground around structure

H. **Grade stake** — Stake driven into ground, usually with top establishing finished level of ground or concrete at that point

(NOTE: Grade for the stake is read from the benchmark.)

I. **Height of instrument (HI)** — Vertical distance from benchmark to line of sight of instrument

J. **Leveling rod** — Rod used with leveling instrument; graduated in tenths and hundredths of a foot or in inches and feet

K. **Transit** — Very precise instrument used to establish straight lines and to measure horizontal and vertical angles

III. Factors pertinent to site layout

A. Local regulations and covenants (zoning and restrictions)

EXAMPLES: Setback line; proximity to side property lines; elevation, size, shape, and proximity to surrounding buildings and areas

B. Location of utilities

EXAMPLES: Electricity, sewers, gas, phone

C. Presence of existing trees and shrubs

D. Contour or shape of site

EXAMPLES: Flat, rolling, sloping

E. Characteristics of soil

F. Orientation of site

EXAMPLES: Relationship to other sites; north, east, south, and west boundaries; wind direction; solar-utilization possibilities

IV. Information used to lay out building lines

A. Dimensions of property

B. Setback from curb

C. Setback from sidewalk

D. Setback from property lines

INFORMATION SHEET

E. Distance from side boundaries

F. Distance from rear property line

G. Location and dimensions of easement(s)

H. Dimensions (length and width) of building

I. Orientation of building on lot (square or diagonal)

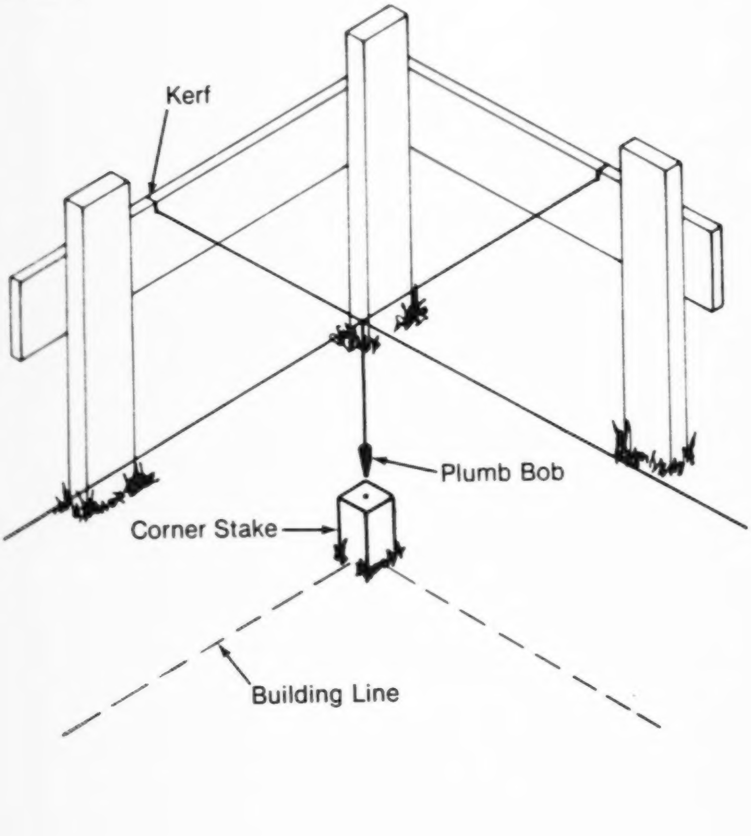
J. Location of benchmark and grade

V. Purpose of batter boards — To provide a place for stretching a line used to establish building lines for excavation and construction (Figure 3)

(NOTE: Steel stakes are sometimes used in place of batter boards.)

EXAMPLE: Using batter boards to set up building lines

FIGURE 3



INFORMATION SHEET

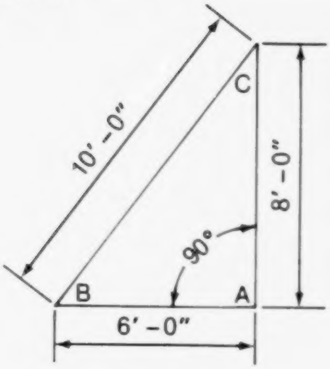
VI. Common methods used to square building lines

A. **3-4-5 rule** — Forming a right triangle using largest multiple of 3-4-5 possible for length of lines being squared, and ensuring that longest side of triangle is exact appropriate multiple of 5

(NOTE: Any multiple of 3-4-5 may be used [i.e., 6-8-10, 12-16-20, 24-32-40] depending on the size being checked.)

EXAMPLE: Using 3-4-5 rule to square building lines 6′ –0″ × 8′ –0″, line BC will measure exactly 10 feet if lines AB and AC are square (Figure 4).

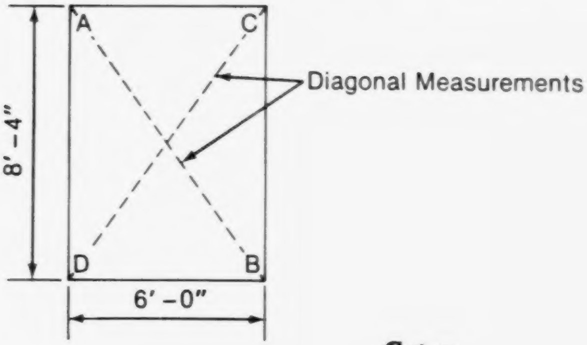
FIGURE 4



B. **Diagonal method** — Measuring diagonally from inside corners of layout and ensuring that diagonal lines are equal in length

EXAMPLE: Using the diagonal method to square building lines 6′ –0″ × 8′ –4″, lines AB and CD will be exactly the same measurement if building lines are square (Figure 5).

FIGURE 5

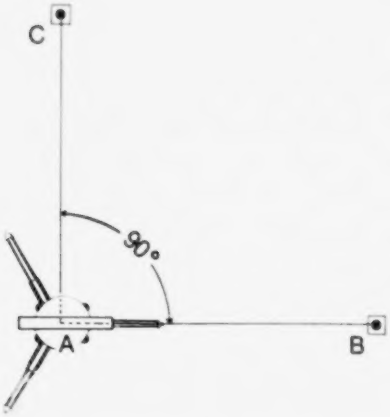


INFORMATION SHEET

C. **Transit method** — Setting instrument exactly at point where right angle is to be, sighting a reference point on one line of angle, setting 360-degree scale at zero, and establishing second line of angle where scale indicates a 90-degree arc has been completed

EXAMPLE: Using instrument to square corners of building lines, when instrument is at point A and sighted on a point on line AB, 360-degree scale will indicate that an arc of 90 degrees has been completed at line AC (Figure 6).

FIGURE 6



SITE LAYOUT
UNIT VI

ASSIGNMENT SHEET #1 — WRITE LAYOUT DIMENSIONS ON A PLOT PLAN

NAME ______________________________ SCORE ______________

In order to be able to lay out a building site correctly, the construction worker must be able to read dimensions on a plot plan.

Review Information Sheet, Sections III and IV, and then write the dimensions below in the correct places on the plot plan on the following page. As you read the plot plan, remember that the scale is the original scale used in making the drawing. The plan has been reduced, and the scale is no longer accurate for the new size.

Property dimensions

- Front—75′-0″
- Rear—75′-0″
- East side—99′-6″
- West side—99′-6″

Building size—65′-0″ × 54′-0″

(NOTE: Building should be parallel with boundary lines.)

Bench mark—100′-0″

Easement—5′-11″ at rear of property

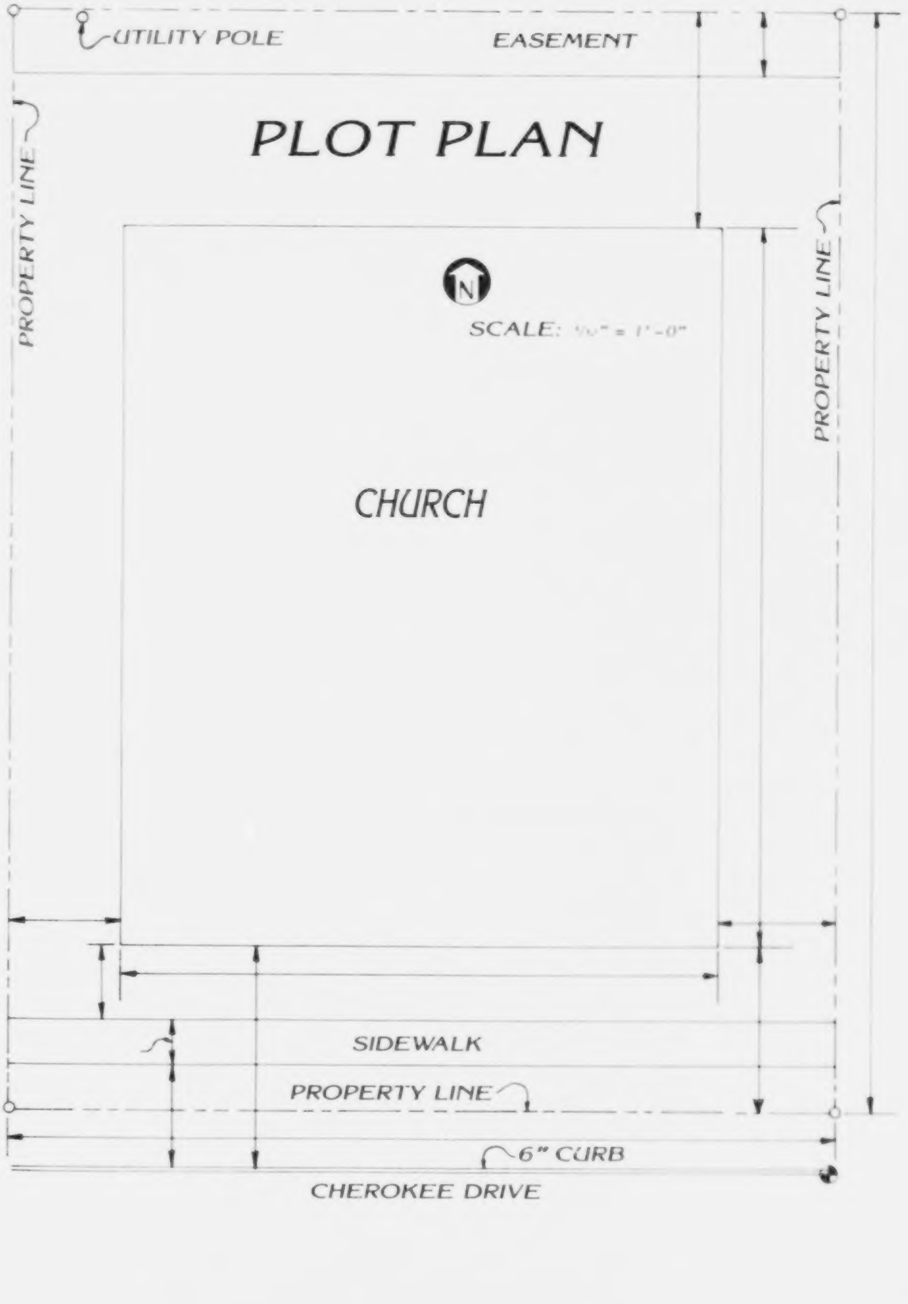
Sidewalk

- 4′-0″ wide
- 6′-10″ from building

Setbacks

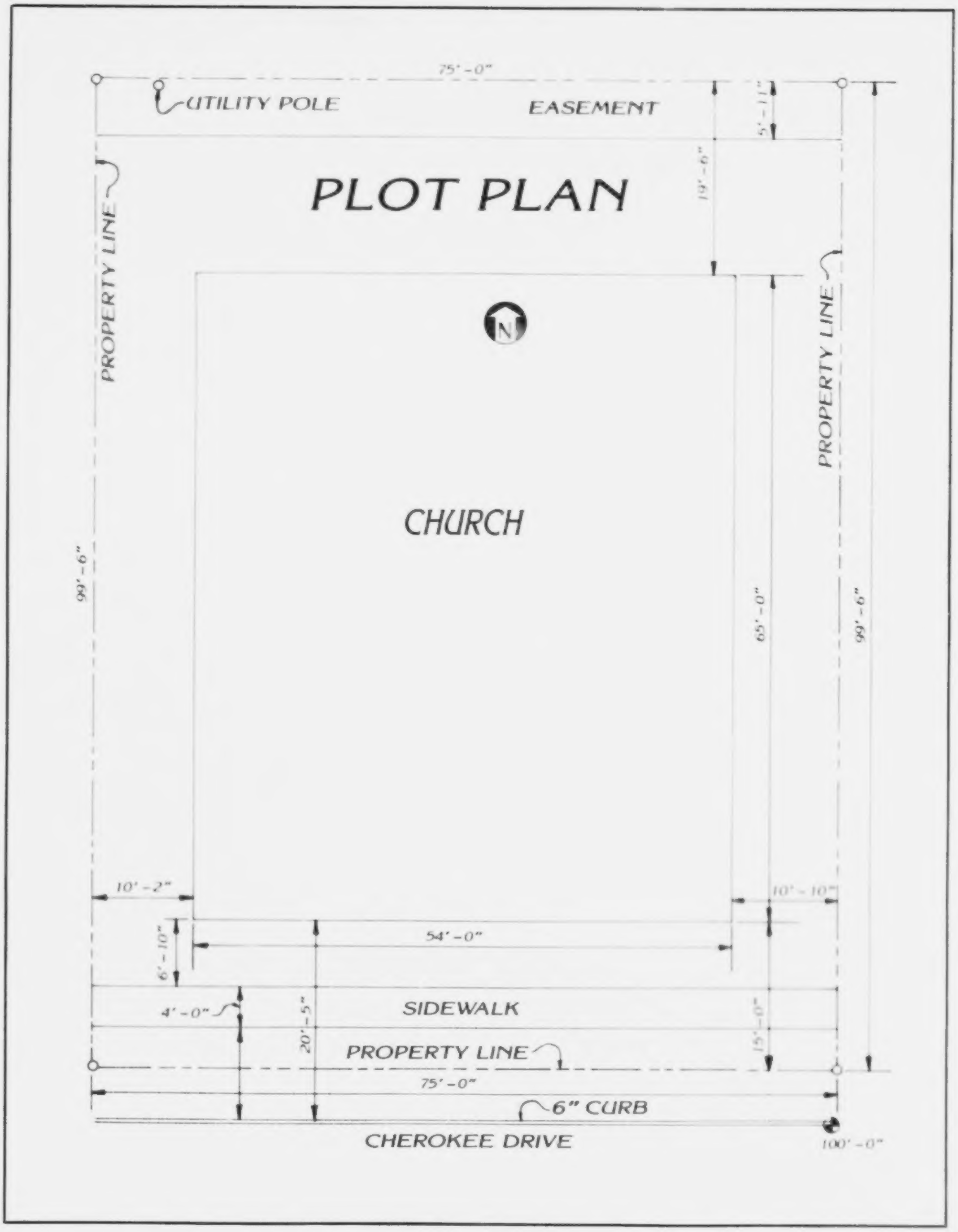
- 20′-5″ from center of curb
- 15′-0″ from south property line
- 10′-2″ from west property line
- 10′-10″ from east property line
- 19′-6″ from north property line

ASSIGNMENT SHEET #1


UTILITY POLE
EASEMENT
PLOT PLAN
PROPERTY LINE
PROPERTY LINE
N
SCALE: 1/16" = 1'-0"
CHURCH
SIDEWALK
PROPERTY LINE
6" CURB
CHEROKEE DRIVE

SITE LAYOUT
UNIT VI

ANSWERS TO ASSIGNMENT SHEET


75'-0"
UTILITY POLE
EASEMENT
5'-11"
19'-6"
PLOT PLAN
PROPERTY LINE
PROPERTY LINE
N
CHURCH
99'-6"
65'-0"
99'-6"
10'-2"
10'-10"
54'-0"
6'-10"
4'-0"
SIDEWALK
20'-5"
15'-0"
PROPERTY LINE
75'-0"
6" CURB
CHEROKEE DRIVE
100'-0"

SITE LAYOUT
UNIT VI

JOB SHEET #1 — ERECT BATTER BOARDS AND LOCATE BUILDING LINES FOR A STRUCTURE

I. Tools and materials

  A. Tools

    1. Sledgehammer
    2. Claw hammer
    3. Crosscut handsaw
    4. Power handsaw and extension cord (if electricity is available on site)
    5. Builder's level and transit
    6. String line
    7. Tapes
    8. Plot plan
    9. Pencil

  B. Materials

    1. Plot plan (located at end of Job Sheet #1)
    2. Batter-board stakes, 2×4s
    3. Ledger boards, 1×6s
    4. Braces (if necessary), 1×4s
    5. Corner stakes, 2×2s
    6. 8d box nails

II. Procedure

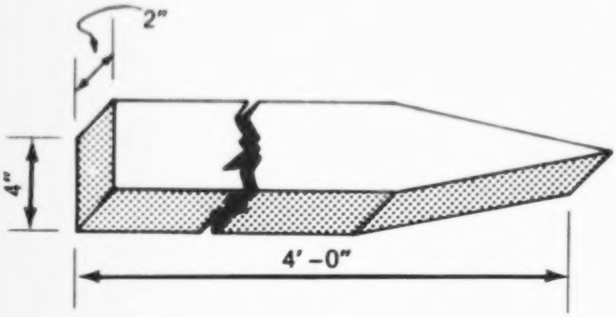
(NOTE: The procedure given in this job sheet is just one of several acceptable methods.)

  A. Cut material to size

JOB SHEET #1

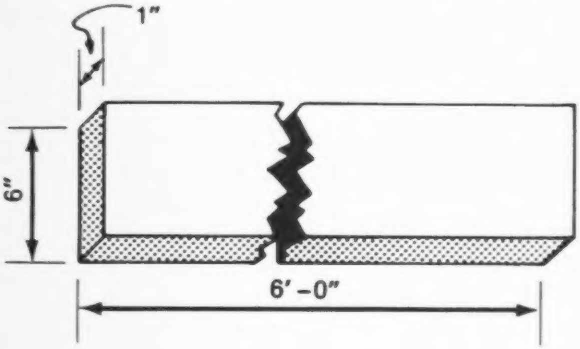
1. Cut batter-board stakes to dimensions and configurations shown in Figure 7

FIGURE 7



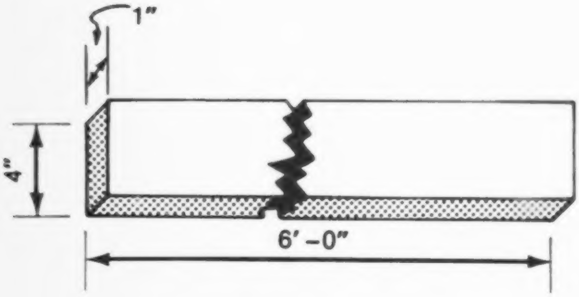
2. Cut ledger boards (Figure 8)

FIGURE 8



3. Cut braces (Figure 9)

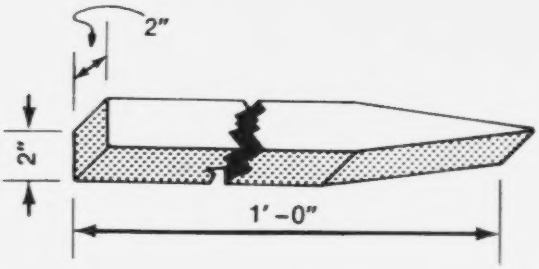
FIGURE 9



JOB SHEET #1

4. Cut corner stakes to dimensions and configurations shown in Figure 10

FIGURE 10



B. Mark property lines with string line

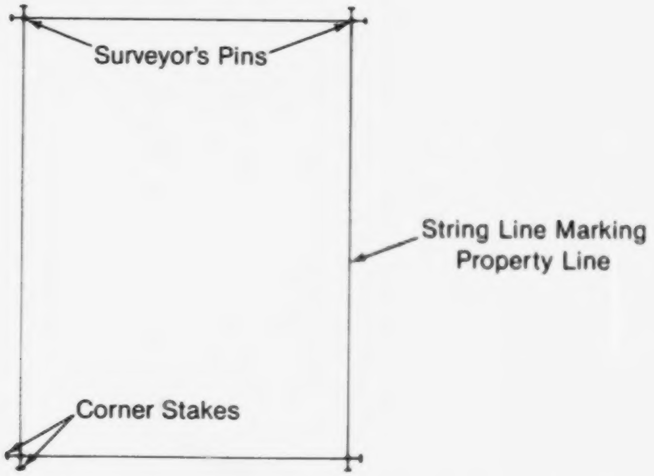
1. Locate surveyor's pins marking four corners of property

2. Set corner stakes beside surveyor's pins (See Figure 11)

3. Attach string line to corner stakes (Figure 11)

(NOTE: Leave property string line in place until exact building lines have been established.)

FIGURE 11



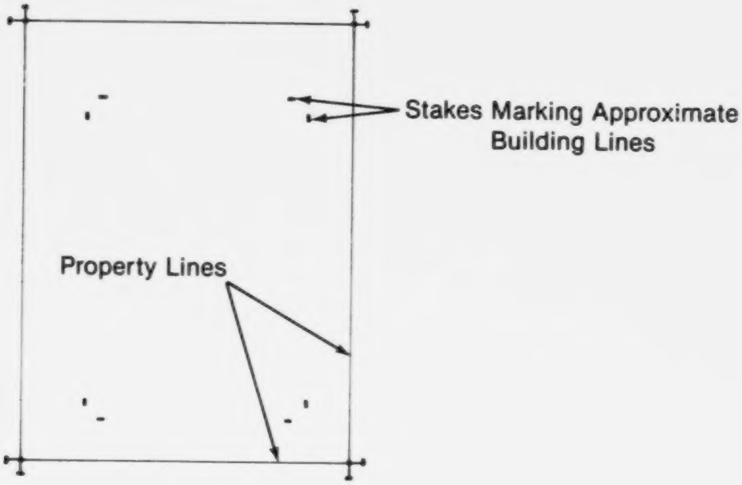
C. Mark approximate location of building lines with string line

1. Using property lines and plot plan as reference, measure to determine approximate location of building lines; mark approximate building lines by driving at least two stakes along each line (See Figure 12)

(NOTE: Nails or other temporary markers may be used to mark these lines.)

JOB SHEET #1

FIGURE 12

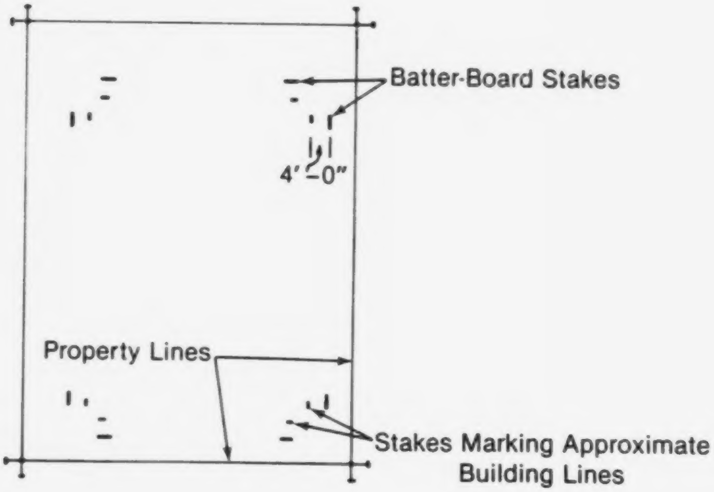

Stakes Marking Approximate Building Lines
Property Lines

2. Erect batter boards

   a. Measure a point at least 4 feet behind each stake marking approximate building lines; drive a batter-board stake at each point (Figure 13)

   (NOTE: When setting batter-board stakes for large structures, set stakes at least 20 feet outside approximate building lines to leave work room for heavy equipment.)

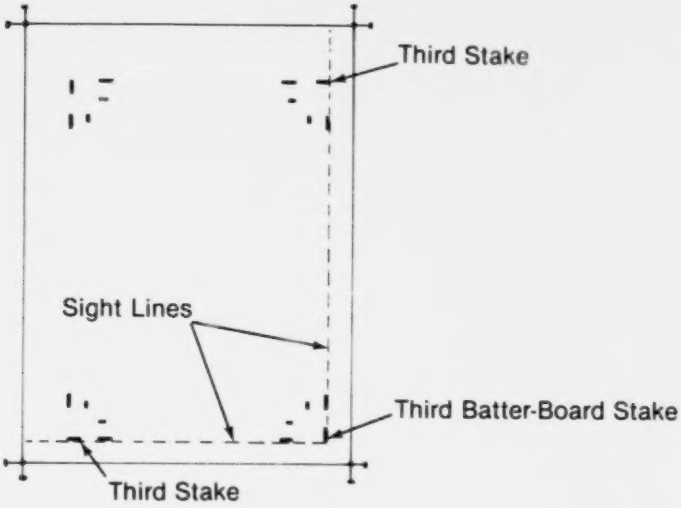
FIGURE 13


Batter-Board Stakes
4'-0"
Property Lines
Stakes Marking Approximate Building Lines

JOB SHEET #1

b. To determine location of corner stake for each batter board, sight a line parallel to two batter board stakes on each line of angle; drive third batter board stake where two lines intersect (Figure 14)

FIGURE 14


Third Stake
Sight Lines
Third Batter-Board Stake
Third Stake

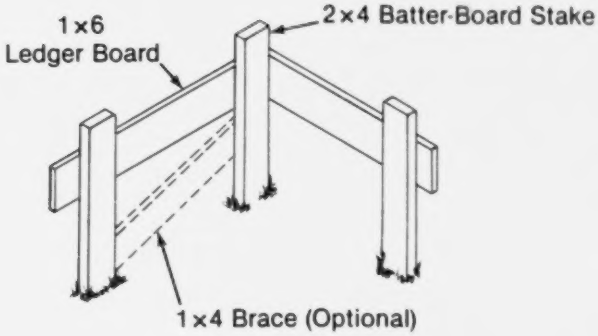
c. Use builder's level to locate elevation on each batter-board stake

d. Nail ledger boards at correct elevation on batter-board stakes (See Figure 15)

e. Nail braces to batter board stakes if necessary (Figure 15)

(NOTE: Braces are used when the soil is loose or when the batter-board stakes must be taller than 3 feet.)

FIGURE 15

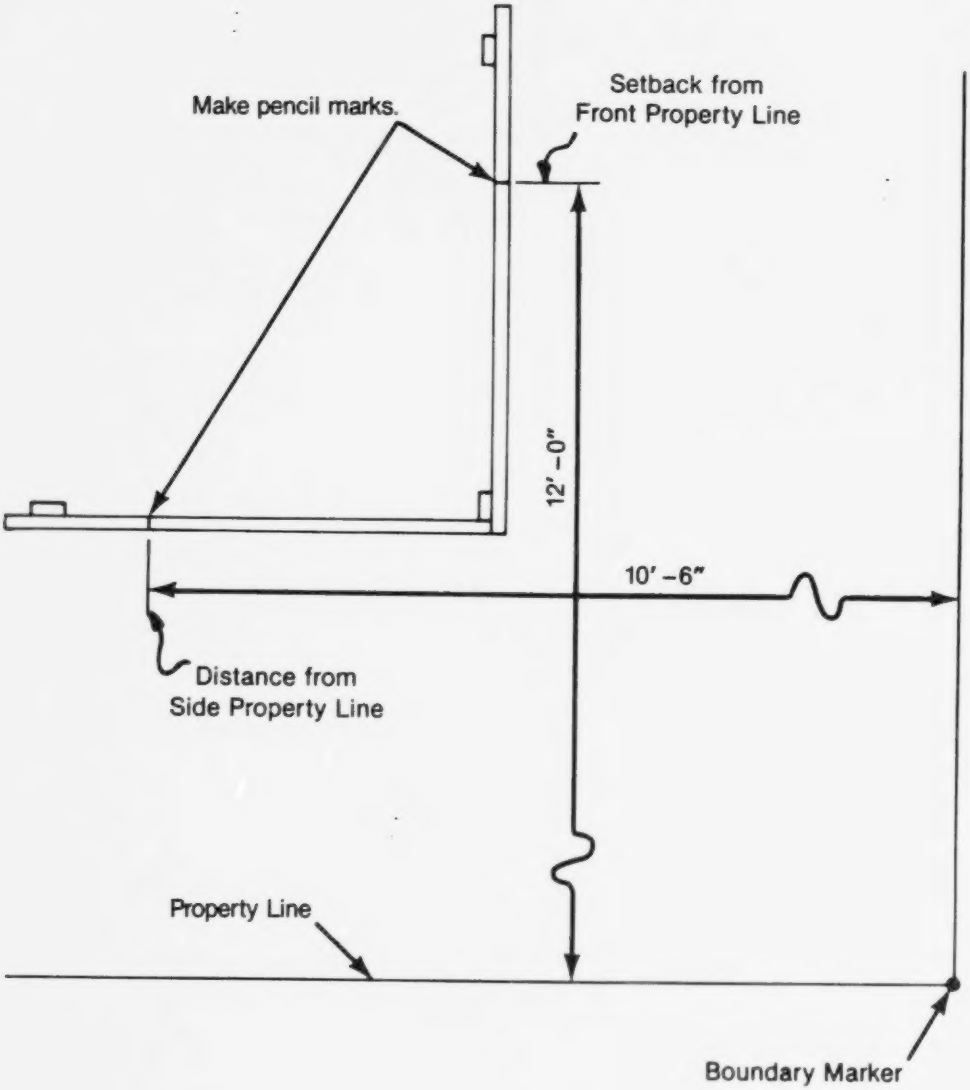

1×6
Ledger Board
2×4 Batter-Board Stake
1×4 Brace (Optional)

JOB SHEET #1

D. Mark permanent building lines with string line

1. Measure from property lines to ledger boards; make pencil mark on top of ledger boards (Figure 16)

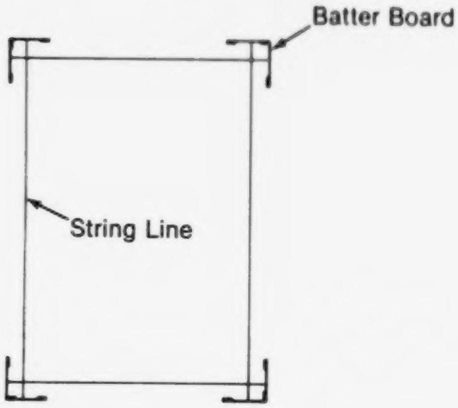
FIGURE 16


Make pencil marks.
Setback from Front Property Line
12' –0"
10' –6"
Distance from Side Property Line
Property Line
Boundary Marker

JOB SHEET #1

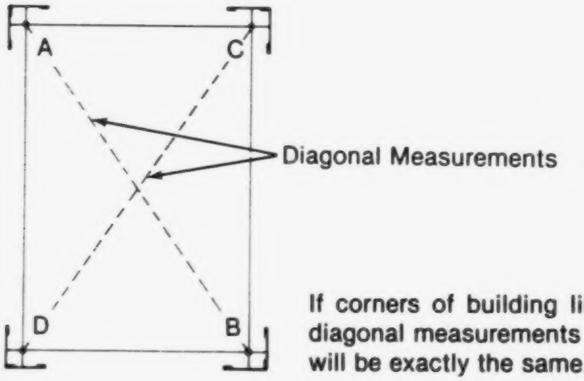
2. Drive nails at pencil marks on ledger boards; attach string lines to nails and stretch as shown in Figure 17

FIGURE 17


Batter Board
String Line

3. Check squareness of corners by using diagonal method (Figure 18), 3-4-5 rule (Figure 19), or transit method (Figure 20), and adjust string lines as necessary

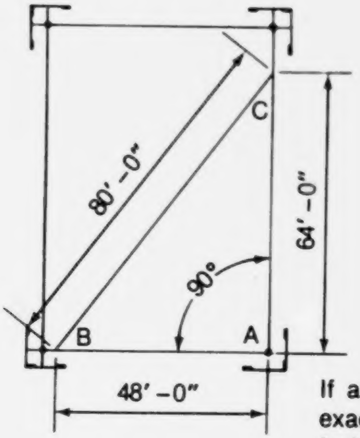
FIGURE 18: Diagonal method


A
C
Diagonal Measurements
D
B

If corners of building lines are square, both diagonal measurements (line AB and line CD) will be exactly the same.

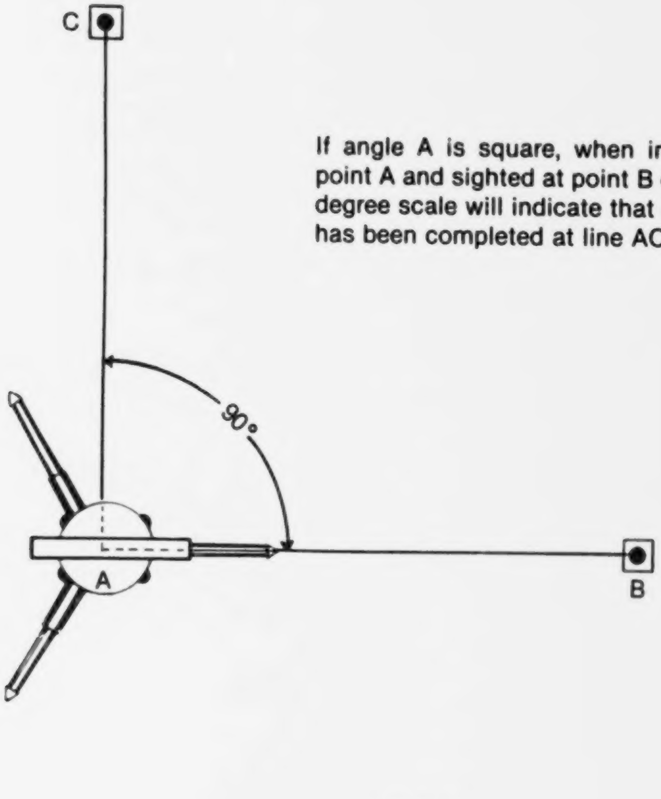
JOB SHEET #1

FIGURE 19: 3-4-5 rule



If angle A is square and measurements are exact, line BC will measure exactly 80 feet (using the 48-64-80 multiple of 3-4-5).

FIGURE 20: Transit method

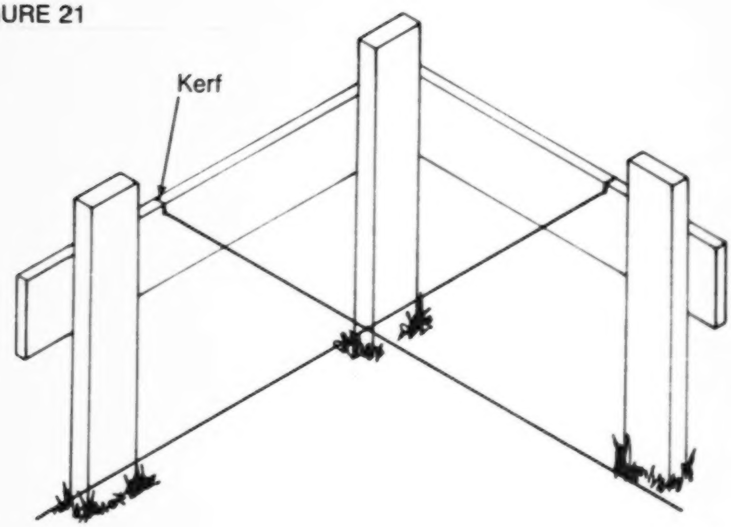


If angle A is square, when instrument is at point A and sighted at point B on line AB, 360-degree scale will indicate that a 90-degree arc has been completed at line AC.

JOB SHEET #1

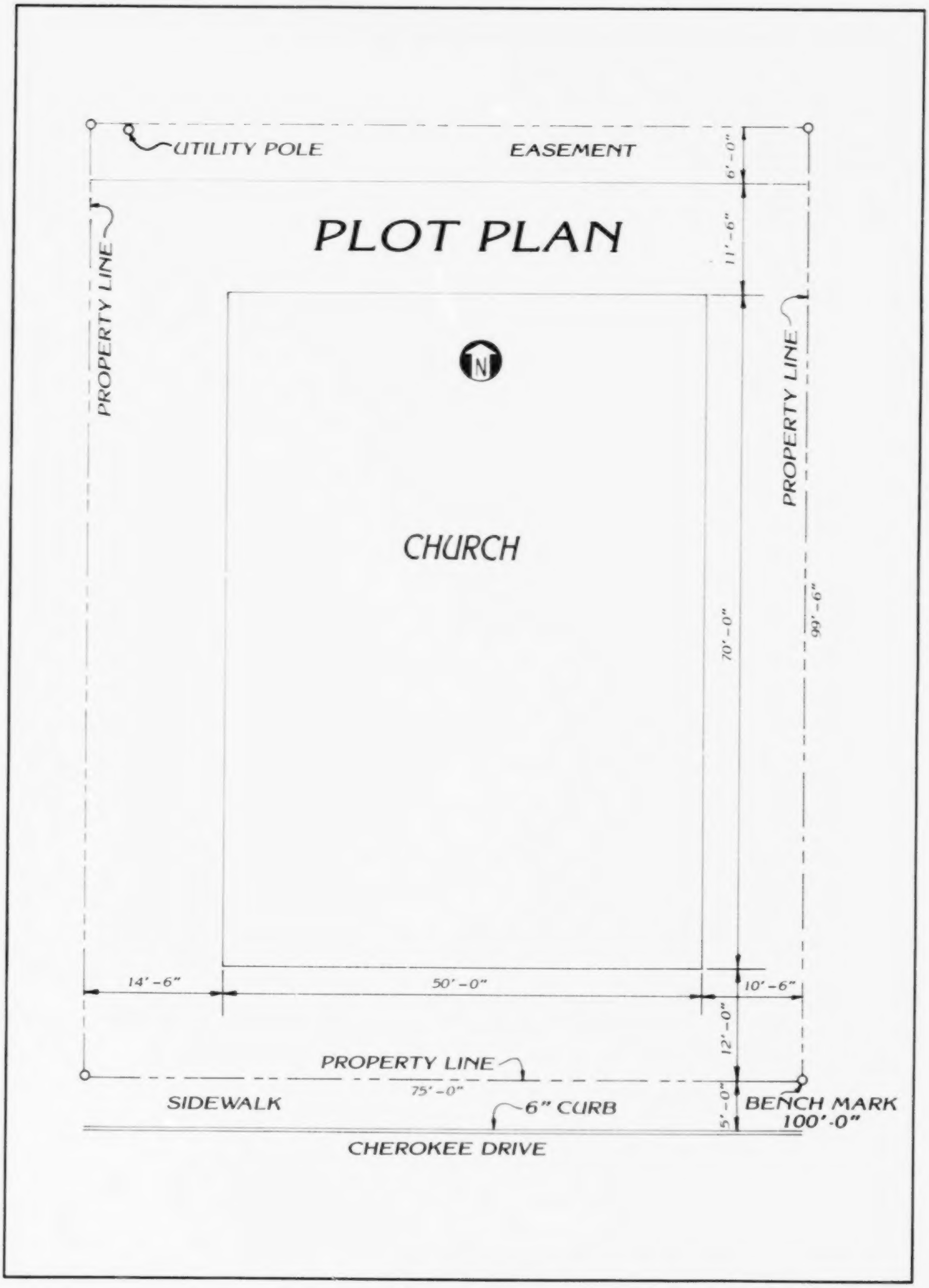
4. After corners have been squared, saw kerf in ledger boards at exact squared location; attach string to kerf to keep string from shifting (Figure 21)

FIGURE 21



E. Clean work area; store tools and materials properly

JOB SHEET #1


UTILITY POLE
EASEMENT
6'-0"
PLOT PLAN
11'-6"
PROPERTY LINE
PROPERTY LINE
CHURCH
70'-0"
99'-6"
14'-6"
50'-0"
10'-6"
12'-0"
PROPERTY LINE
75'-0"
SIDEWALK
6" CURB
5'-0"
BENCH MARK
100'-0"
CHEROKEE DRIVE

SITE LAYOUT
UNIT VI

JOB SHEET #2 — LAY OUT FOOTINGS FOR A STRUCTURE

I. Tools and materials

  A. Foundation plan (located at end of Job Sheet #2)

  B. Floor plan (located at end of Job Sheet #2)

  C. Plumb bob

  D. Pencil

  E. String line

  F. Tape

  G. Sledgehammer

  H. Claw hammer

  I. Crosscut handsaw

  J. Power handsaw and extension cord (if electricity is available on site)

  K. Builder's level

  L. 8d box nails

  M. Corner stakes, 2" x 2" x 1'

  N. Footing-line stakes, 2" x 4" x 18"

II. Procedure

  A. Locate building lines (See Job Sheet #1)

  B. Locate and drive grade stakes

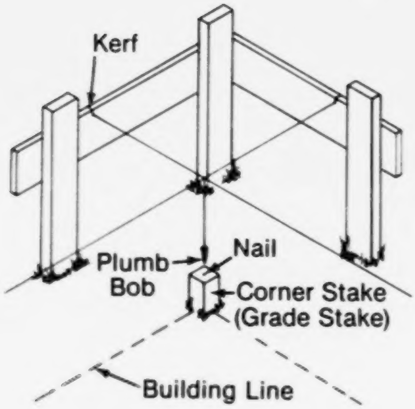
    1. Plumb down from intersection of string lines marking each corner of building lines; drive corner stakes (grade stakes) at these points (See Figure 22)

    2. Use builder's level to establish grade

    3. Drive nail in top of each grade stake to locate exact point of intersection (See Figure 22)

JOB SHEET #2

FIGURE 22


Kerf
Plumb Bob
Nail
Corner Stake (Grade Stake)
Building Line

4. Remove plumb bob

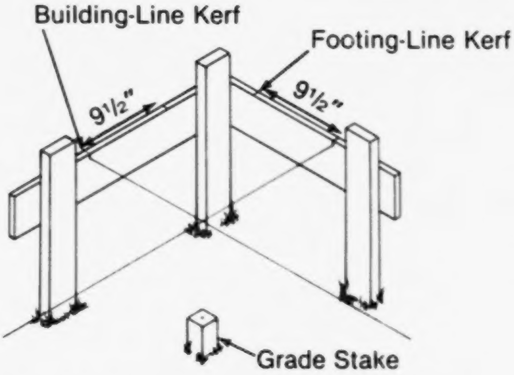
C. Establish footing lines on batter boards

1. Determine from foundation plan and floor plan how far outside of building lines the footing forms will extend

   (NOTE: Since footings are 2 feet wide and the finished walls are 8 inches thick, the footing lines will have to be set 8 inches both ways from the building lines, and another 1½ inches will have to be added to allow for the thickness of the forms on each side.)

2. Measure over 9½ inches from building-line kerf; mark this measurement on top of batter boards, and saw kerf on this mark (Figure 23)

FIGURE 23


Building-Line Kerf
Footing-Line Kerf
9½"
9½"
Grade Stake

3. Drive a nail into ledger board at kerf

   (NOTE: The nail at this point will help distinguish footing line from building line.)

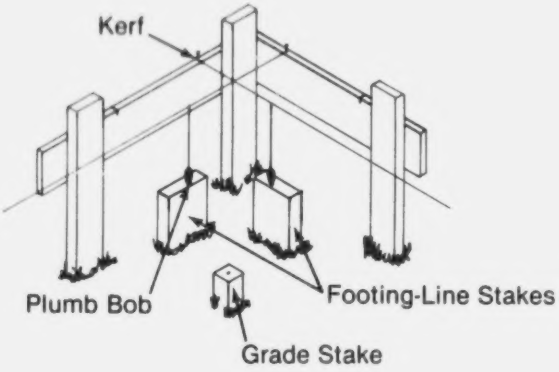
JOB SHEET #2

4. Perform this procedure on all batter boards
5. Move string line from building-line kerfs to footing-line nails and stretch from one footing-line nail to the next, continuing around proposed structure

D. Set form stakes

1. Use plumb bob to locate position of footing-line stakes at each corner of proposed structure (Figure 24)

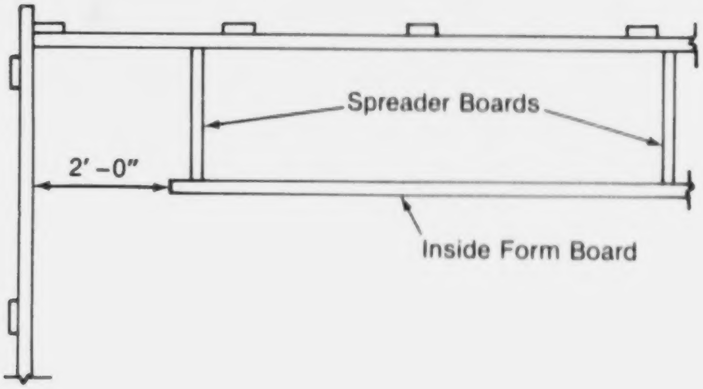
FIGURE 24



2. Transfer grade from grade stakes to footing-line stakes
3. Remove grade stakes
4. Attach string line to stakes; stretch the line tightly from one footing-line stake to the one on opposite end of footing; center the line on the grade that was transferred to those stakes
5. Lay out form boards along the footing line
6. Set stakes approximately every 4 feet, and nail form boards on grade to these stakes to establish the outside forms
7. Cut two spreader boards 2 feet long and place against outside forms; set inside form board against these spreaders (See Figure 25)

JOB SHEET #2

FIGURE 25



8. Set stakes for inside form

   (NOTE: When driving stakes against inside form, drive stakes straight down so that there is no force against the form, which would tend to move the outside form out of line.)

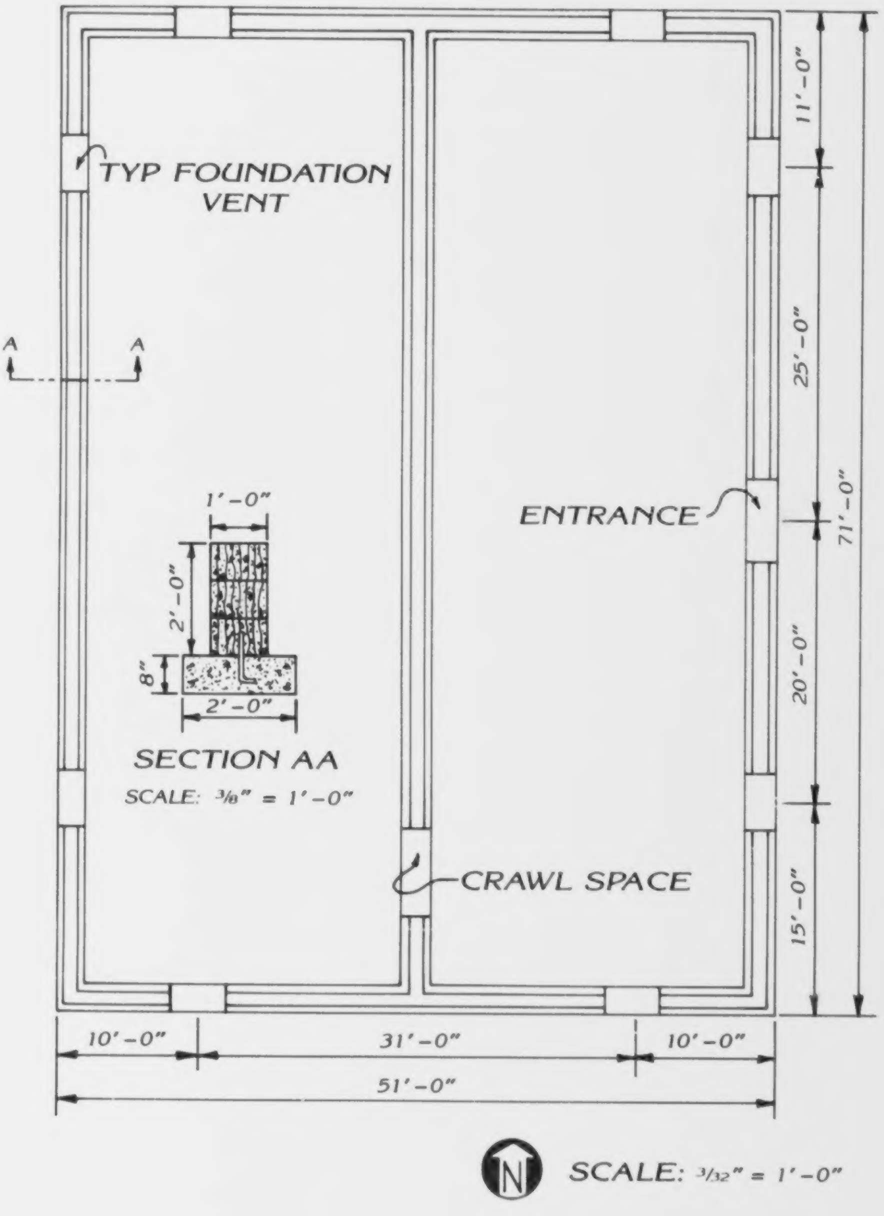
9. Continue setting stakes and nailing forms to grade until all forms are set

   (NOTE: Alignment of forms can be checked by using the plumb bob attached to the string line.)

E. Clean work area; store all tools and materials properly

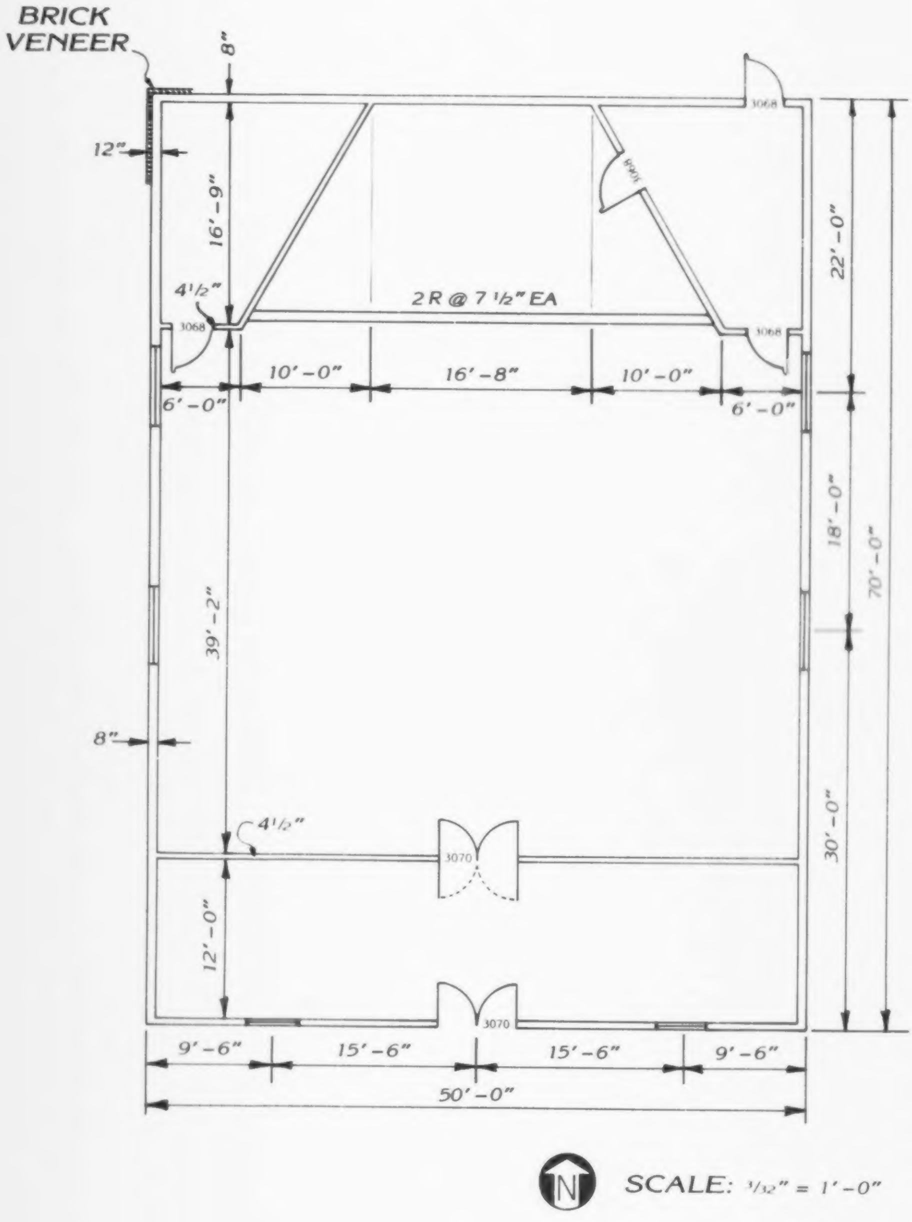
JOB SHEET #2

FOUNDATION PLAN


TYP FOUNDATION VENT
A
A
1'-0"
2'-0"
8"
2'-0"
SECTION AA
SCALE: 3/8" = 1'-0"
ENTRANCE
CRAWL SPACE
11'-0"
25'-0"
20'-0"
15'-0"
71'-0"
10'-0"
31'-0"
10'-0"
51'-0"
N
SCALE: 3/32" = 1'-0"

JOB SHEET #2

FLOOR PLAN


BRICK VENEER
8"
12"
16'-9"
4½"
3068
3068
3068
3068
2 R @ 7 ½" EA
22'-0"
10'-0"
16'-8"
10'-0"
6'-0"
6'-0"
18'-0"
70'-0"
39'-2"
8"
4½"
3070
30'-0"
12'-0"
3070
9'-6"
15'-6"
15'-6"
9'-6"
50'-0"
N
SCALE: 3/32" = 1'-0"

SITE LAYOUT
UNIT VI

JOB SHEET #3 — SET GRADE STAKES FOR FOOTINGS WITHOUT FORMS

I. Tools and materials

- A. Foundation plan provided by instructor
- B. Builder's level and rod
- C. Sledgehammer
- D. 18-inch-long reinforcement bars to use as grade stakes

  (NOTE: 2×4 or 1×4 stakes could also be used as grade stakes.)

II. Procedure

(NOTE: After footings have been excavated, it is necessary to set grade stakes for concrete.)

- A. In the center of the footing excavation, drive stakes every 8 feet to 10 feet
- B. Set each stake at grade
  1. While an assistant shoots grade with builder's level, hold rod on top of stake
  2. Remove rod and drive stake with sledgehammer until top of stake is approximately on grade
  3. Hold rod on top of stake and check grade
  4. Continue driving stake and rechecking grade until stake is on grade
- C. Clean work area; store all tools and materials properly

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FOC-495-B

SITE LAYOUT
UNIT VI

TEST

NAME ______________________ SCORE __________

1. Match to their correct definitions terms associated with site layout. Write the correct numbers in the blanks.

_____a. Tool or device attached to a string; used to set or check plumb or perpendicular of a surface

_____b. To plumb from a given point down to a point below

_____c. A vested or acquired right to use land, other than as a tenant, for a specific purpose; such right being held by someone other than the owner who holds the title to the land

_____d. Removing soil for footing or for establishing a uniform grade

_____e. Top horizontal board on batter-board framework

_____f. Drawing used to show location and size of structure(s), driveways, sidewalks, patios, property lines, utilities, and existing conditions

_____g. Temporary framework on which to stretch a line to assist in locating corners and building lines when laying out a building

_____h. Agreement between builder and city that specifies the type, quality, and extent of construction on structure to be erected

_____i. Boundaries of a lot or plot of ground

_____j. Slight indentation made with a saw; used to hold line in place

_____k. Line established by law, fixing exterior face of structure a minimum distance from right-of-way or property line

_____l. Art or science of determining the area and configuration of portions of the earth's surface

1. Excavating
2. Property lines
3. Plumb bob
4. Surveying
5. Kerf
6. Batter board
7. Setback line
8. Ledger board
9. Plumb down
10. Building permit
11. Plot plan
12. Easement

TEST

2. Match to their correct definitions terms pertaining to grades and leveling instruments. Write the correct numbers in the blanks.

_____a. Vertical distance from benchmark to line of sight of instrument

_____b. The slope of a line, usually expressed as inches per foot of run

_____c. Proposed or future level of ground around structure

_____d. Permanent point of known or assumed elevation

_____e. Rod used with leveling instrument; graduated in tenths and hundredths of a foot or in inches and feet

_____f. Elevation of finished floor in relation to benchmark

_____g. Soil or other substance used to raise grade level

_____h. Instrument consisting of a telescope, leveling bubble, and tripod; used primarily for establishing grade levels

_____i. Stake driven into ground, usually with top establishing finished level of ground or concrete at that point

_____j. Given grade

_____k. Very precise instrument used to establish straight lines and to measure horizontal and vertical angles

1. Grade line
2. Fall
3. Leveling rod
4. Transit
5. Grade stake
6. Benchmark (BM)
7. Height of instrument (HI)
8. Fill
9. Builder's level
10. Finish-floor grade
11. Elevation

3. Name factors pertinent to site layout.

a.____

b.____

c.____

d.____

e.____

f.____

TEST

4. Select from the following list information used to lay out building lines. Write an "X" in the blank before each correct answer.

______a. Dimensions (length and width) of building

______b. Setback from property lines

______c. Direction building faces

______d. Location of all utilities on plot

______e. Location of benchmark and grade

______f. Location and dimensions of easement(s)

______g. Distance from utility pole to building

______h. Setback from curb

______i. Orientation of building on lot (square or diagonal)

______j. Location of water supply

______k. Dimensions of property

______l. Setback from sidewalk

5. State the purpose of batter boards.

____

____

6. Describe common methods used to square building lines.

a. 3-4-5 rule—____

____

____

b. Diagonal method—____________________________________

____

____

____

TEST

c. Transit method—______________________________

____

____

____

(NOTE: Test question 7 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

7. Demonstrate the ability to
   a. Erect batter boards and locate building lines for a structure.
   b. Lay out footings for a structure.
   c. Set grade stakes for footings without forms.

SITE LAYOUT
UNIT VI

ANSWERS TO TEST

1. a. 3
   b. 9
   c. 12
   d. 1
   e. 8
   f. 11
   g. 6
   h. 10
   i. 2
   j. 5
   k. 7
   l. 4

2. a. 7
   b. 2
   c. 1
   d. 6
   e. 3
   f. 10
   g. 8
   h. 9
   i. 5
   j. 11
   k. 4

3. a. Local regulations and covenants (zoning and restrictions)
   b. Location of utilities
   c. Presence of existing trees and shrubs
   d. Contour or shape of site
   e. Characteristics of soil
   f. Orientation of site

4. a, b, e, f, h, i, k, l

5. To provide a place for stretching a line used to establish building lines for excavation and construction

6. Description should include the following

   a. 3-4-5 rule—Forming a right triangle using largest multiple of 3-4-5 possible for length of lines being squared, and ensuring that longest side of triangle is exact appropriate multiple of 5

   b. Diagonal method—Measuring diagonally from inside corners of layout and ensuring that diagonal lines are equal in length

   c. Transit method—Setting instrument exactly at point where right angle is to be, sighting a reference point on one line of angle, setting 360-degree scale at zero, and establishing second line of angle where scale indicates a 90-degree arc has been completed

7. Performance skills evaluated to the satisfaction of the instructor

TOOLS AND EQUIPMENT RELATED TO ALL CRAFTS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to identify tools and equipment used by all crafts and equipment used for specific construction jobs. The student should also be able to use hand signals in maneuvering and forklift operations. The student will show this knowledge by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Identify hand tools and equipment used by all crafts.
2. Identify power tools and equipment used by all crafts.
3. Identify equipment used for specific construction jobs.
4. Distinguish among hand signals used in maneuvering operations.
5. Distinguish among hand signals used in forklift operations.

TOOLS AND EQUIPMENT RELATED TO ALL CRAFTS
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Assignment sheets

      1. Assignment Sheet #1 — Distinguish Among Hand Signals Used in Maneuvering Operations

      2. Assignment Sheet #2 — Distinguish Among Hand Signals Used in Forklift Operations

   E. Answers to assignment sheets

   F. Test

   G. Answers to test

II. Instructor's guide

   A. Obtain materials to supplement unit.

      1. Competency profiles

         (NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364 or from The Associated General Contractors of America, 1957 E Street N.W., Washington, DC 20006; phone 202-393-2040.)

      2. Catalogs from various equipment manufacturers

   B. Make additional copies of assignment sheet if needed.

   C. Provide students with objective sheet.

   D. Discuss unit and specific objectives.

      - Emphasize the importance of being able to identify the many kinds of equipment. Stress that although this equipment is usually furnished by the employer or contractor, these tools of the trade may be used by all crafts and by the student as long as the student works in construction.

SUGGESTED ACTIVITIES

- Point out the importance of observing proper safety precautions when handling equipment.
- Emphasize the importance of taking proper care of all equipment.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss hand tools and equipment used by all crafts.
    - Make a set of flash cards containing pictures of related tools and equipment. Show students flash cards and have them identify the picture and write their answers on a sheet of paper.
    - Plan a field trip to a construction site to see how many different kinds of hand tools and equipment are used on the job and how they are being used.
2. Use Information Sheet, Section II, to discuss power tools and equipment related to all crafts.
    - Make a set of flash cards containing pictures of related power tools and equipment. Show students flash cards and have them identify the picture and write their answers on a sheet of paper.
    - Plan a field trip to the site of a large construction job to see how some of the power equipment shown in this unit is being used.
    - Have students identify power tools and equipment in the shop or work area and tell how they may be used.
3. Use Information Sheet, Section III, to discuss equipment used for specific jobs.
    - Have students take pictures or cut pictures out of magazines and newspapers illustrating such equipment being used on the job.
    - Have students survey the community to determine where such equipment is being used.
4. Use Information Sheet, Sections IV and V, and Assignment Sheets #1 and #2 to discuss hand signals used in maneuvering and forklift operations.
    - Have students complete Assignment Sheets #1 and #2; critique and discuss the assignment sheets in class.
    - Have students pair off and practice giving and receiving hand signals. You might take students outside and space them far enough apart so that they cannot talk to each other when practicing hand signals.
    - Have students practice hand signals in a simulated job situation.

SUGGESTED ACTIVITIES

G. Give test.

H. Critique test and discuss it in class.

I. Reteach if necessary.

J. Complete appropriate section of competency profiles.

III. Unit reference

Hendrix, Laborn J., "Bud." *Fundamentals of Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1985.

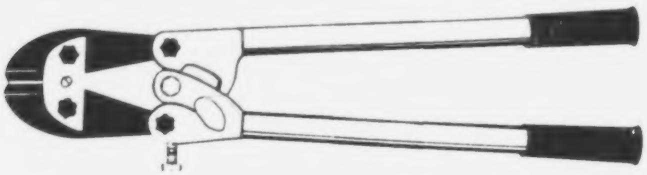
TOOLS AND EQUIPMENT RELATED TO ALL CRAFTS
UNIT I

INFORMATION SHEET

I. Hand tools and equipment used by all crafts (Figures 1-39)

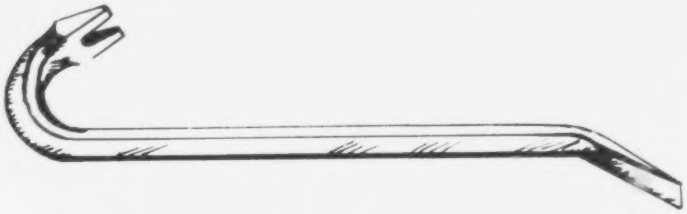
A. Bolt cutters

FIGURE 1



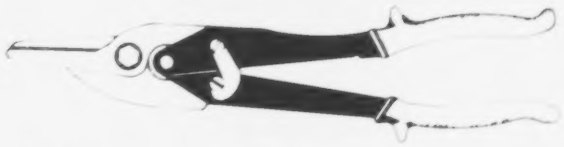
B. Wrecking bar

FIGURE 2



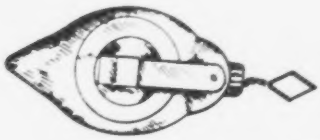
C. Metal snips

FIGURE 3



D. Chalk box and line

FIGURE 4

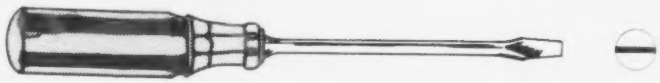


INFORMATION SHEET

E. Screwdrivers

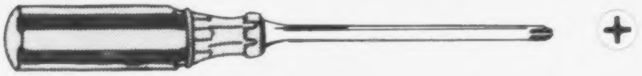
1. Standard (flat blade)

FIGURE 5



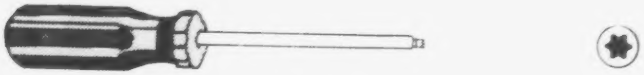
2. Phillips

FIGURE 6



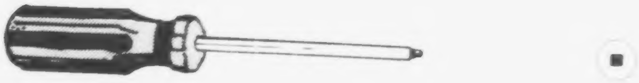
3. Torx-head

FIGURE 7



4. Square-head (Robertson)

FIGURE 8

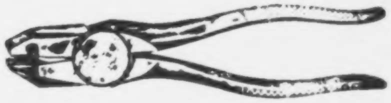


INFORMATION SHEET

F. Pliers

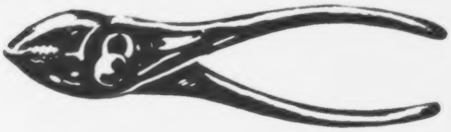
1. Side cut

FIGURE 9



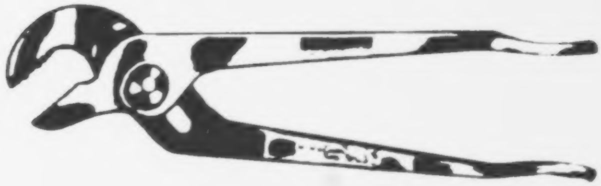
2. Combination slip-joint

FIGURE 10



3. Channel-lock

FIGURE 11

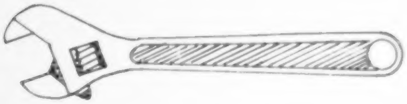


INFORMATION SHEET

G. Wrenches

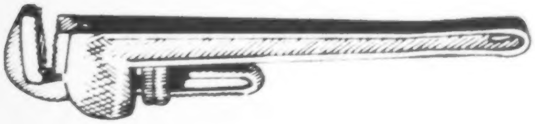
1. Adjustable

FIGURE 12



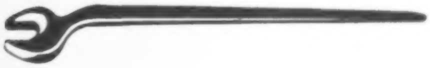
2. Pipe

FIGURE 13



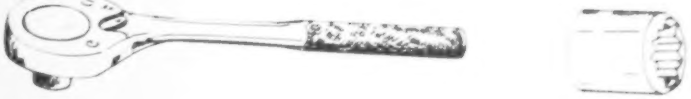
3. Spud (structural)

FIGURE 14



4. Ratchet wrench and socket

FIGURE 15

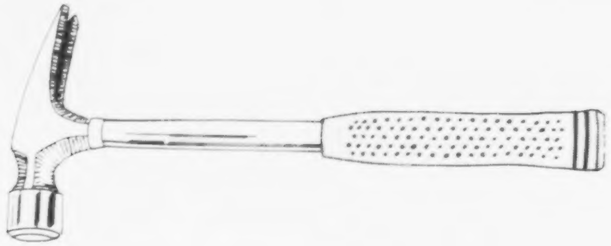


INFORMATION SHEET

H. Hammers

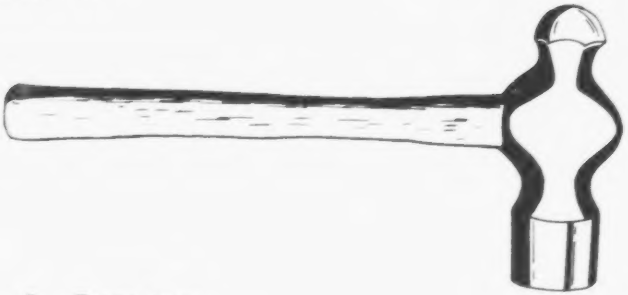
1. Claw

FIGURE 16



2. Ball peen

FIGURE 17

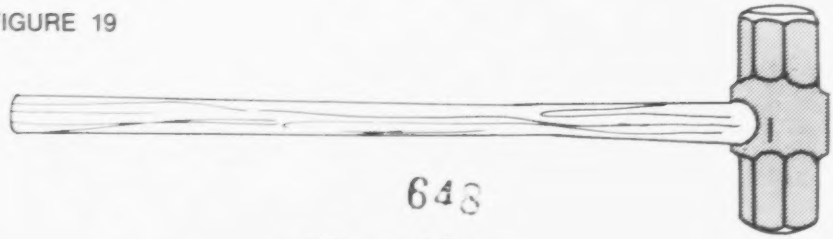


3. Cross peen

FIGURE 18

4. Sledge

FIGURE 19

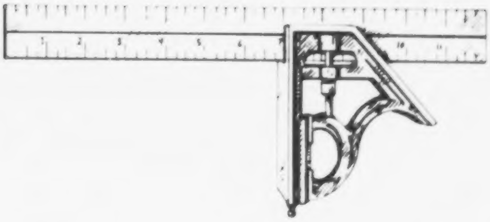


INFORMATION SHEET

I. Squares

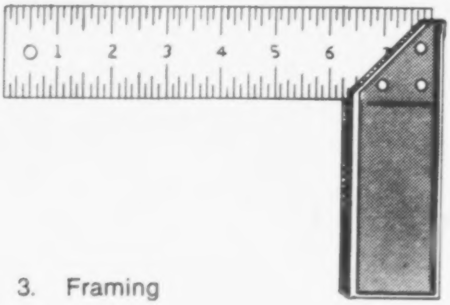
1. Combination

FIGURE 20



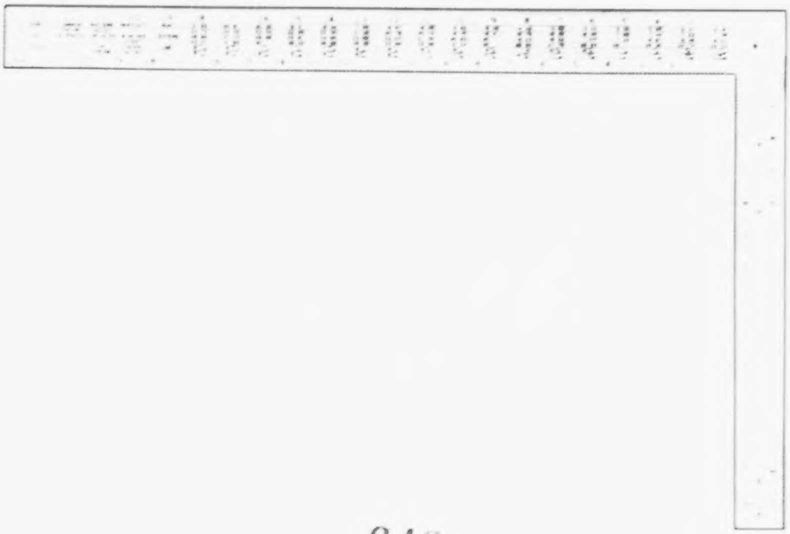
2. Try

FIGURE 21



3. Framing

FIGURE 22

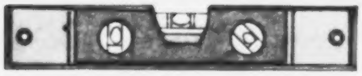


INFORMATION SHEET

J. Hand levels

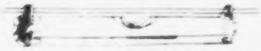
1. Torpedo

FIGURE 23



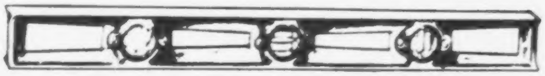
2. Line

FIGURE 24



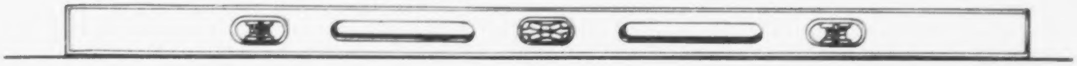
3. Aluminum utility

FIGURE 25



4. 48-inch mason's

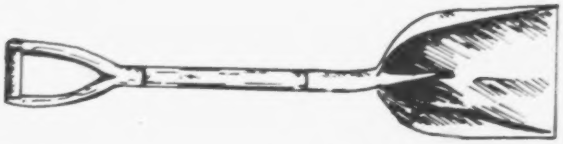
FIGURE 26



K. Shovels

1. Scoop

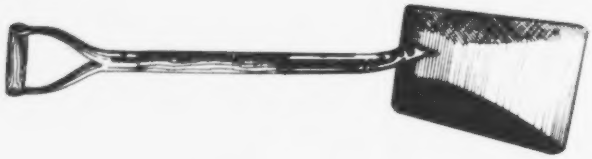
FIGURE 27



INFORMATION SHEET

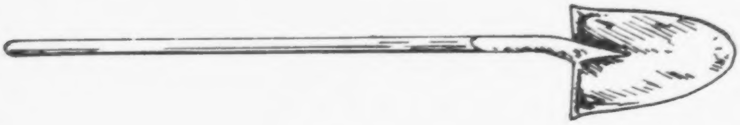
2. D-handled, square point

FIGURE 28



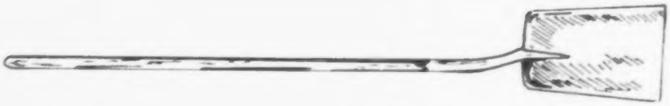
3. Long-handled, round point

FIGURE 29



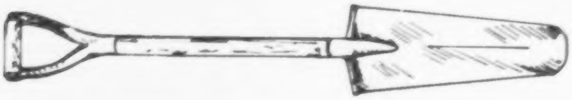
4. Long-handled, square point

FIGURE 30



5. Spade (sharpshooter)

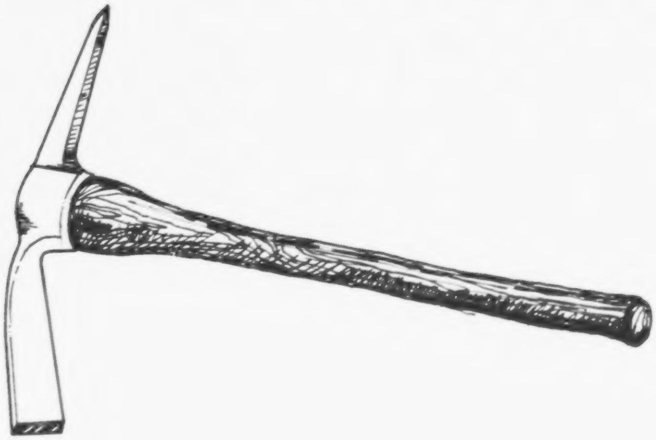
FIGURE 31



INFORMATION SHEET

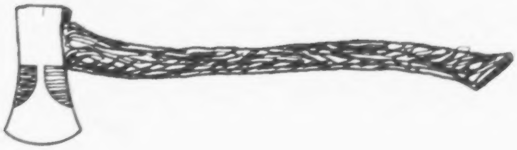
L. Mattock

FIGURE 32



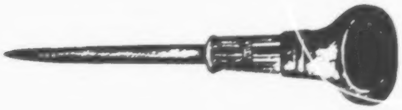
M. Axe

FIGURE 33



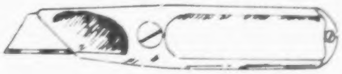
N. Scratch awl

FIGURE 34



O. Utility knife

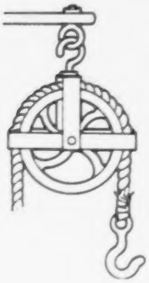
FIGURE 35



INFORMATION SHEET

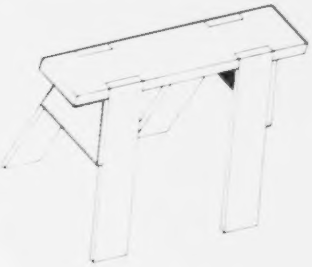
P. Well pulley

FIGURE 36



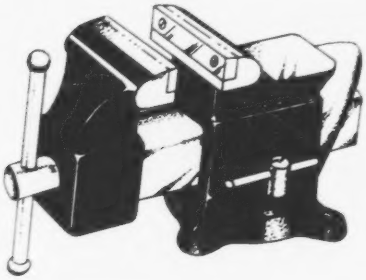
Q. Sawbuck (sawhorse)

FIGURE 37



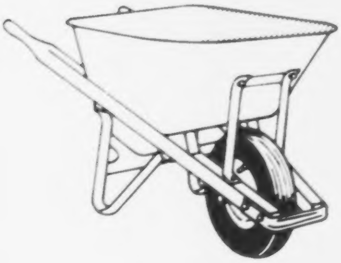
R. Bench vise

FIGURE 38



S. Wheelbarrow

FIGURE 39

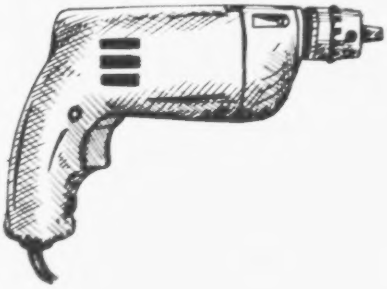


II. Power tools and equipment used by all crafts (Figures 40-58)

A. Hand drills

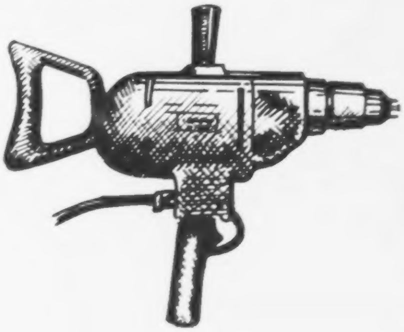
1. ¼-inch hand drill

FIGURE 40



2. ½-inch hand drill

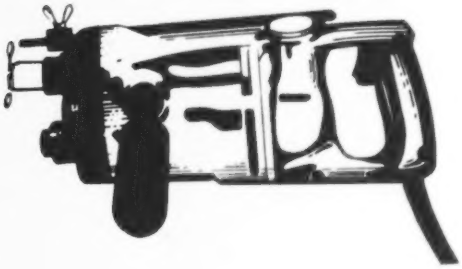
FIGURE 41



INFORMATION SHEET

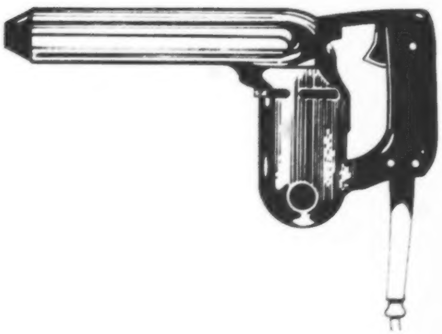
B. Rotary hammer

FIGURE 42



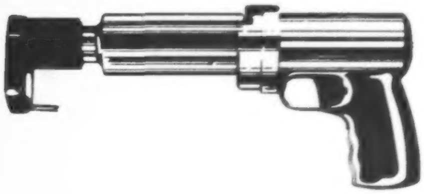
C. Electric percussion hammer

FIGURE 43



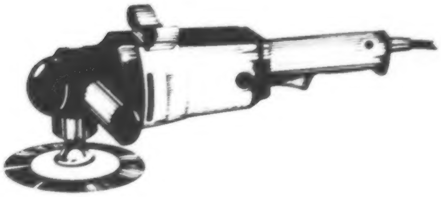
D. Powder-actuated tool

FIGURE 44



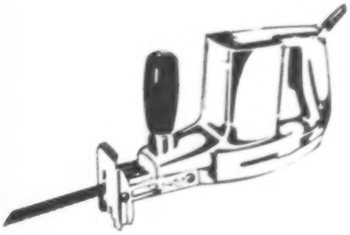
E. Portable angle grinder

FIGURE 45



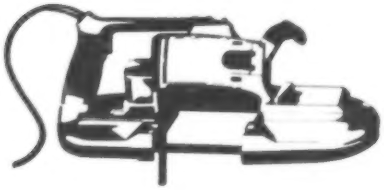
F. Reciprocating saw

FIGURE 46



G. Band saw

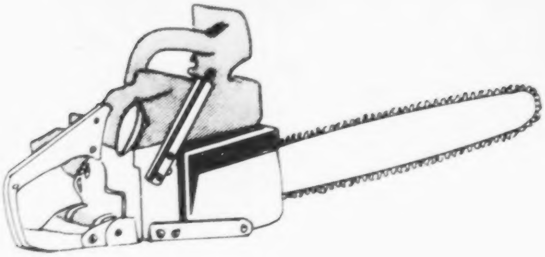
FIGURE 47



INFORMATION SHEET

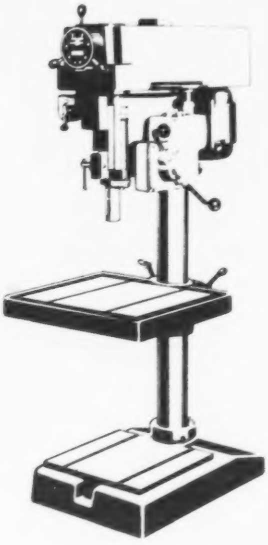
H. Chain saw

FIGURE 48



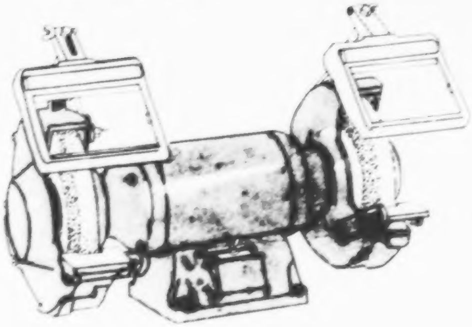
I. Drill press

FIGURE 49



J. Bench grinder

FIGURE 50



K. Air compressors

FIGURE 51 Gasoline

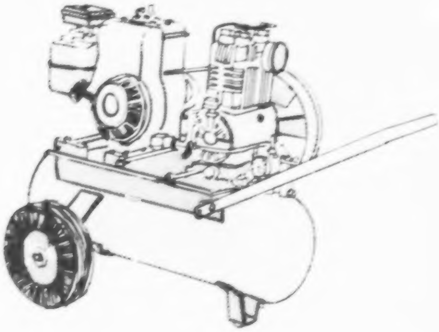
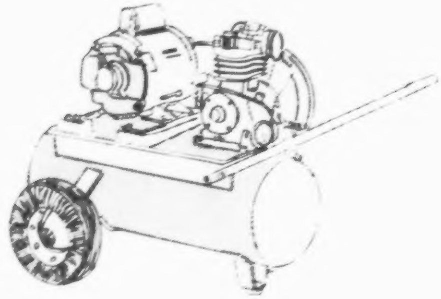


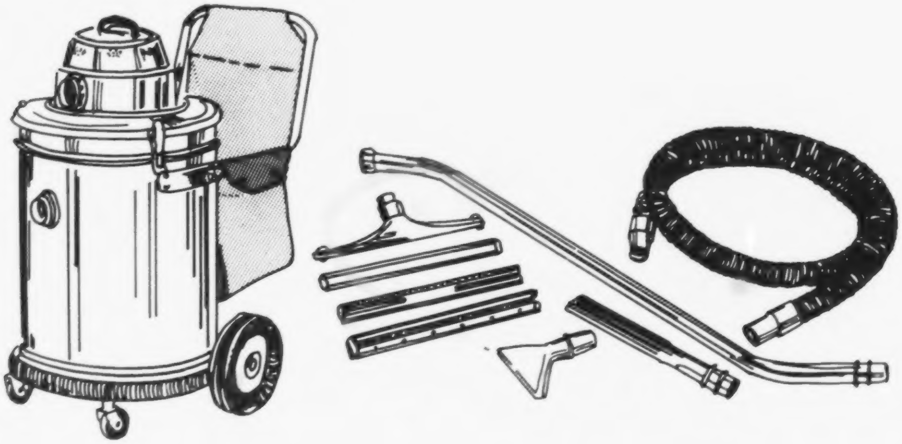
FIGURE 52 Electric



INFORMATION SHEET

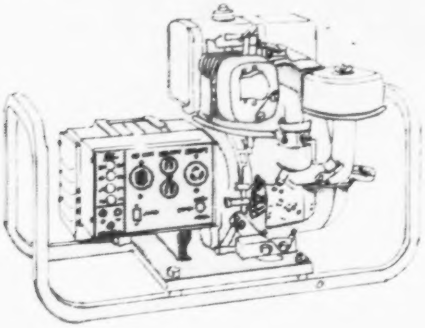
L. Vacuum cleaner and accessories

FIGURE 53



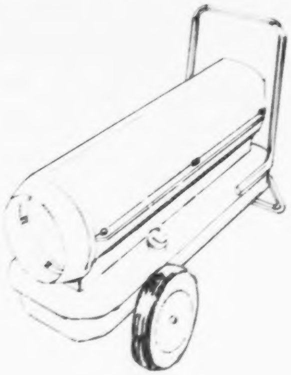
M. Alternator (generator)

FIGURE 54



N. Space heater

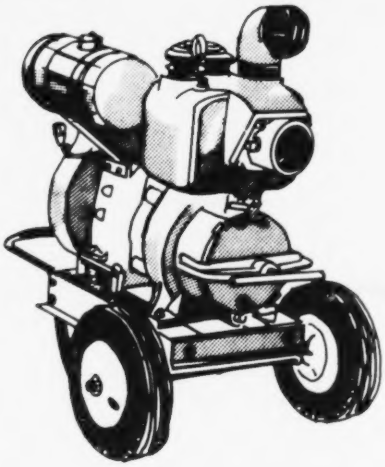
FIGURE 55



INFORMATION SHEET

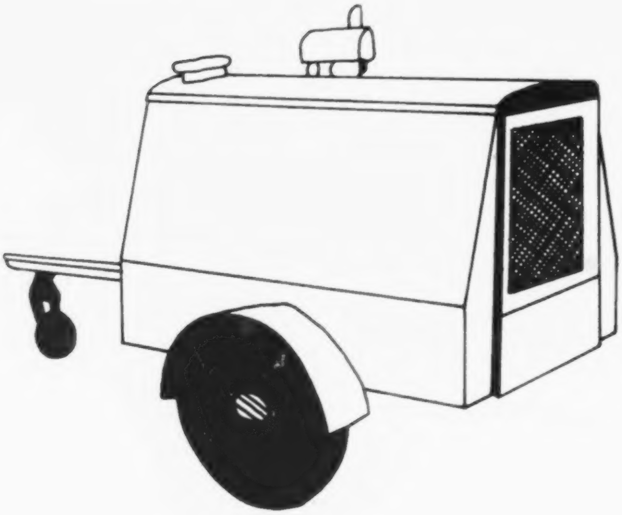
O. Water pump

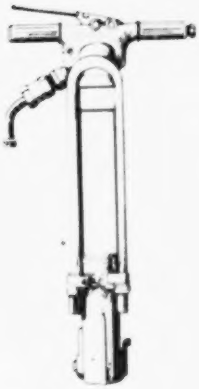
FIGURE 56



P. Air compressor and paving breaker

FIGURE 57





INFORMATION SHEET

Q. Power lift

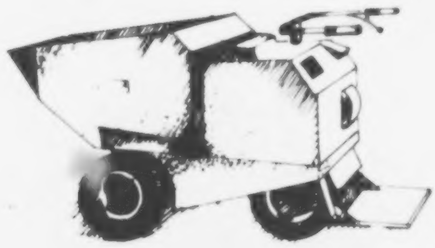
FIGURE 58

Used with permission of Mark Industries, Long Beach, California.

III. Equipment used for specific construction jobs (Figures 59-64)

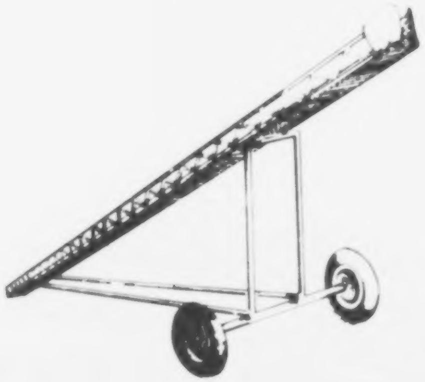
A. Power buggy

FIGURE 59



B. Conveyor

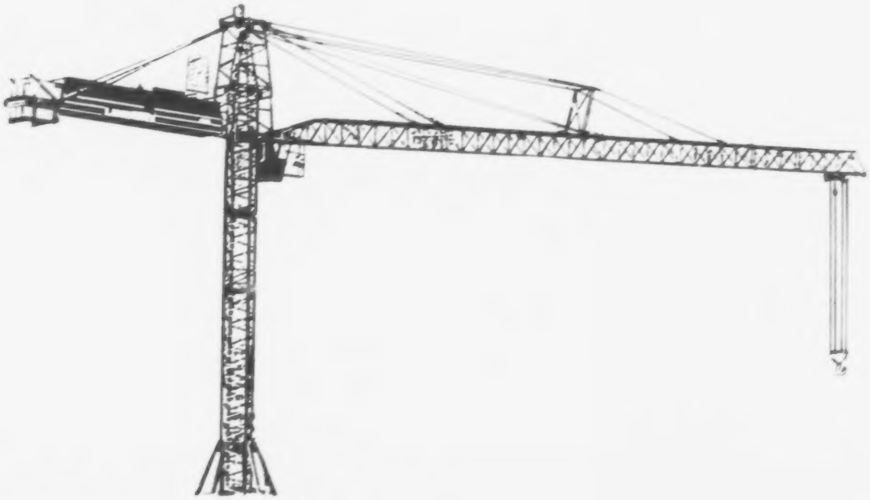
FIGURE 60



INFORMATION SHEET

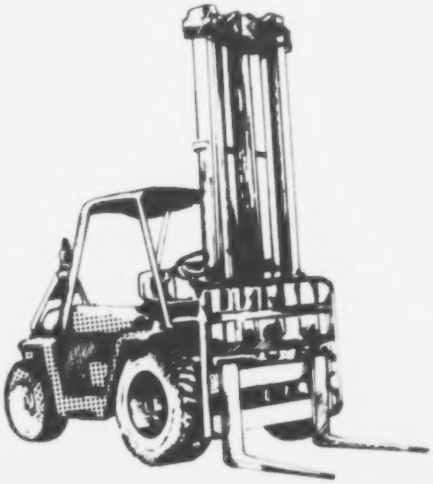
C. Tower crane

FIGURE 61



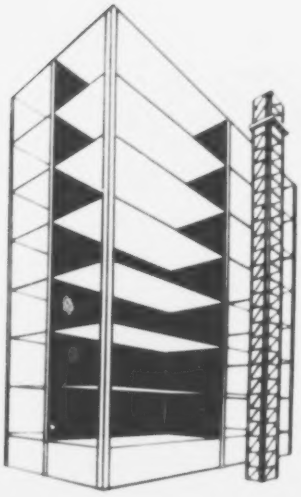
D. Forklift

FIGURE 62



E. Vertical hoist

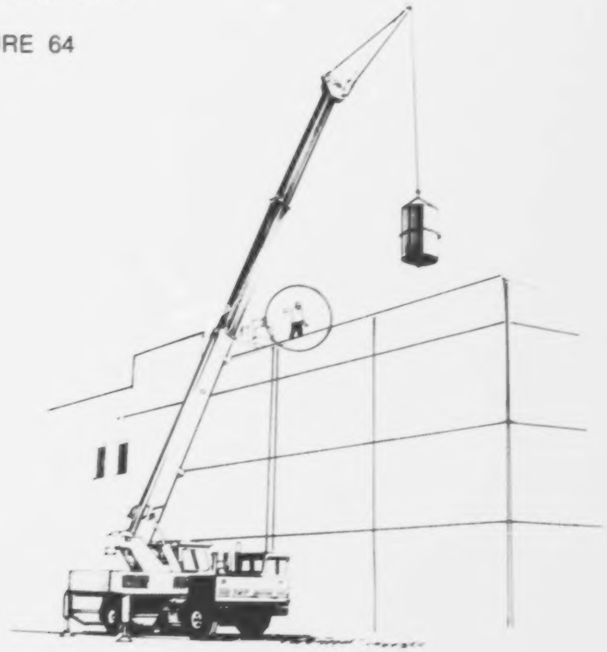
FIGURE 63



INFORMATION SHEET

F. Mobile crane

FIGURE 64

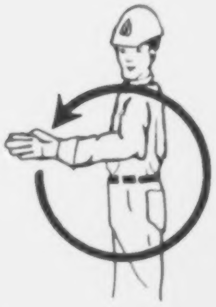


Used with permission of the Construction Safety Association of Ontario, from the *Crane Handbook*, compiled by D.E. Dickie, 1975.

IV. Hand signals used in maneuvering operations (Figures 65-69)

A. Move

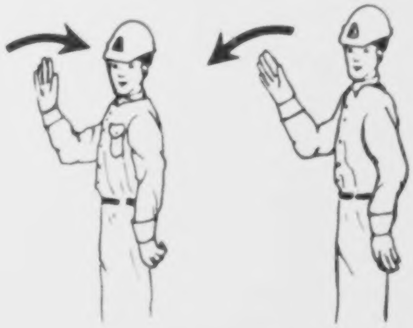
FIGURE 65



Extend forearm forward and rotate in direction of motion.

B. Move backward or forward

FIGURE 66

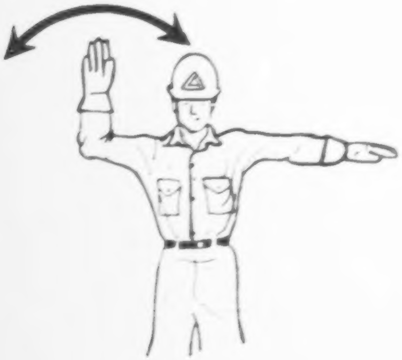


Extend arm forward, forearm vertical, hand open, palm forward; move arm in direction of motion.

INFORMATION SHEET

C. Turn while moving

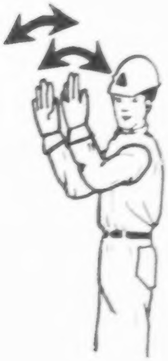
FIGURE 67



One forearm vertical, palm facing forward, move arm back and forth to indicate movement; other arm extended, palm down, point in direction of turn.

D. Straighten out

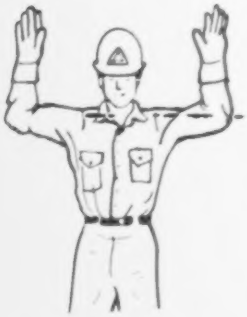
FIGURE 68



Both arms extended forward, forearms vertical, hands open, one palm facing out and the other facing in; move forearms forward and back.

E. Stop

FIGURE 69



Hold both arms to the side, forearms vertical, hands open, palms facing out.

INFORMATION SHEET

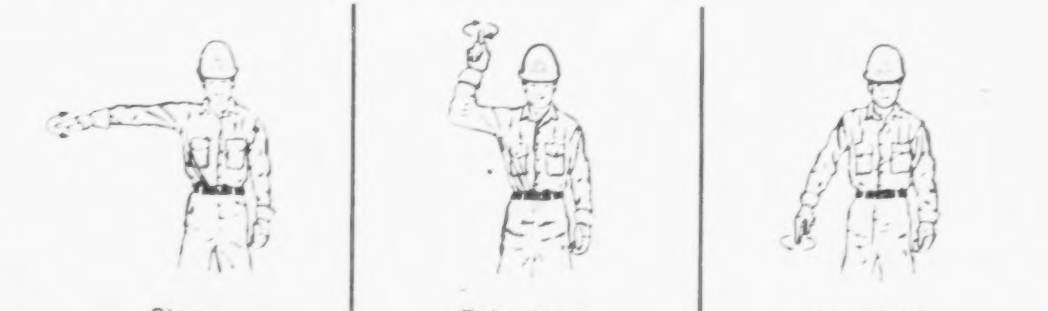
INSTRUCTIONS TO SIGNAL PERSON

1. Only one person will be signal person
2. Make sure the operator can see you and is able to acknowledge the signal given
3. Signal person must watch the load—the operator is watching you
4. Never raise or lower load over other workers; warn them to keep out of the way

WATCH FOR OVERHEAD LINES OR OTHER OBSTRUCTIONS

V. Hand signals used in forklift operations (Figure 70)

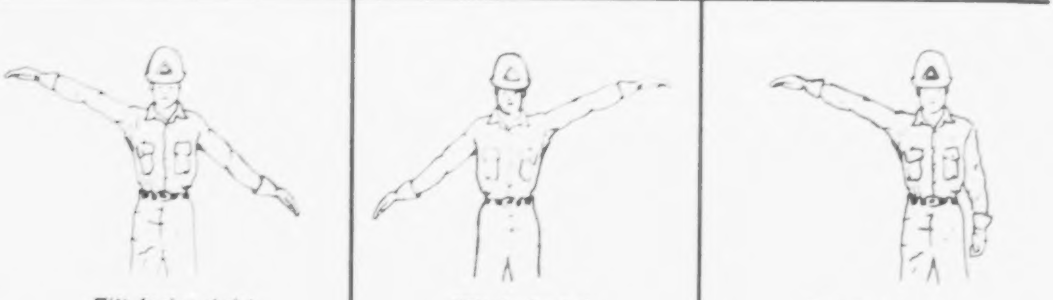
FIGURE 70



Stop

Raise Load

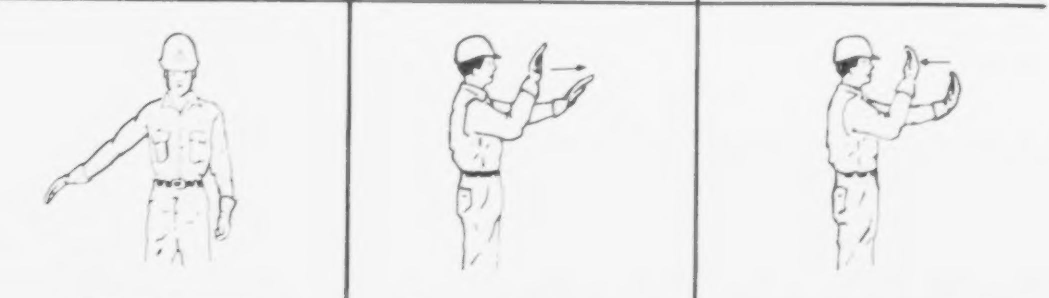
Lower load



Tilt forks right

Tilt forks left

Tilt forks up



Tilt forks down

Move load backward

Move load forward

TOOLS AND EQUIPMENT RELATED TO ALL CRAFTS
UNIT I

ASSIGNMENT SHEET #1 — DISTINGUISH AMONG HAND SIGNALS USED IN MANEUVERING OPERATIONS

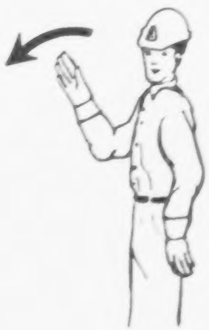
NAME ______________________________ SCORE ______________

Construction workers who use various types of vehicles must know how to use hand signals for maneuvering those vehicles to avoid injuries and damage. Knowing how to use the proper hand signals, you may help another worker avoid a dangerous situation or serious accident.

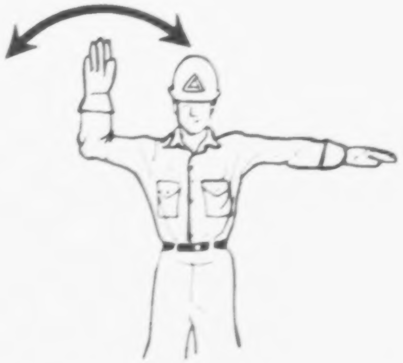
PART I

Distinguish among the following hand signals for maneuvering vehicles. Write an "X" in the blank under each correct illustration.

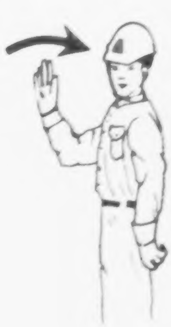
A. Turn while moving



1. ______________

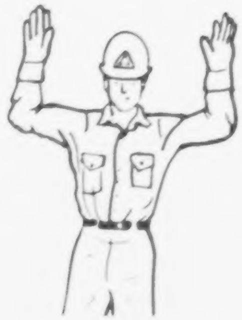


2. ______________

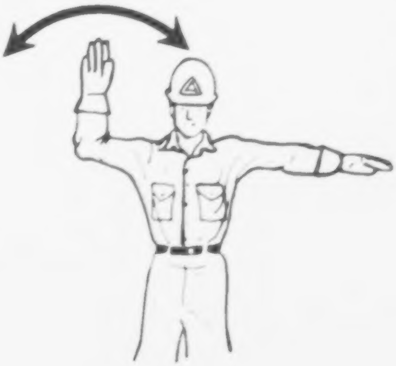


3. ______________

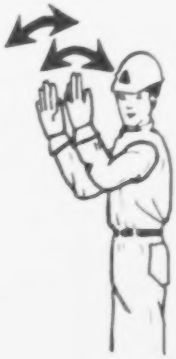
B. Stop



1. ______________



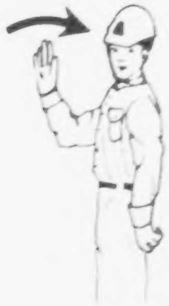
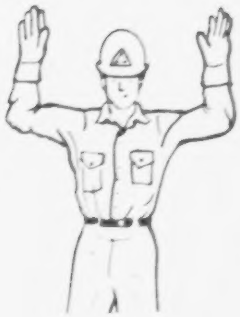
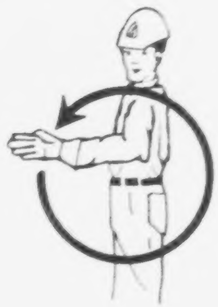
2. ______________



3. ______________

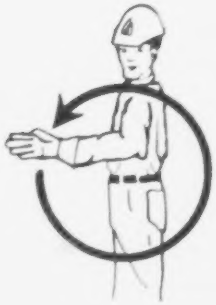
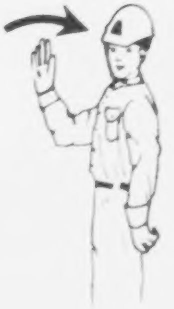
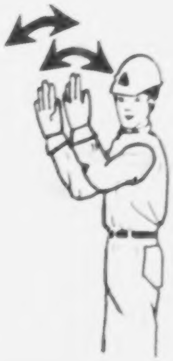
ASSIGNMENT SHEET #1

C. Move

1. ____________________ 2. ____________________ 3. ____________________

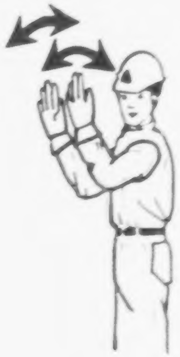
D. Move backward

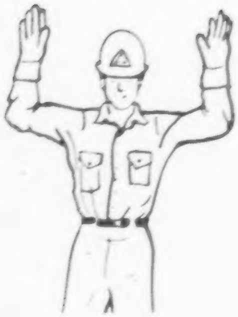




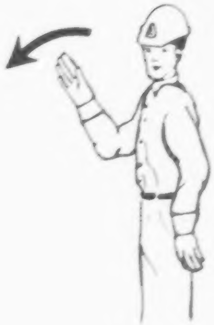
1. ____________________ 2. ____________________ 3. ____________________

ASSIGNMENT SHEET #1

E. Straighten out







1. ____________________ 2. ____________________ 3. ____________________

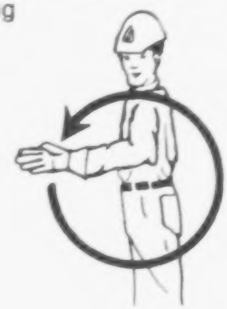
PART II

Distinguish among the following hand signals by writing an "X" in each correct blank.

A. ______1. Turn while moving

______2. Stop

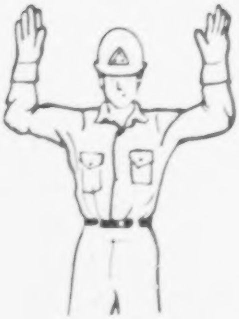
______3. Move



B. ______1. Move

______2. Stop

______3. Straighten out

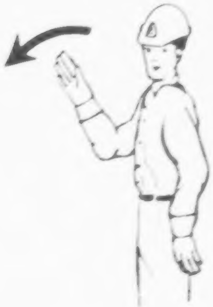


ASSIGNMENT SHEET #1

C. ______1. Straighten out

______2. Move backward

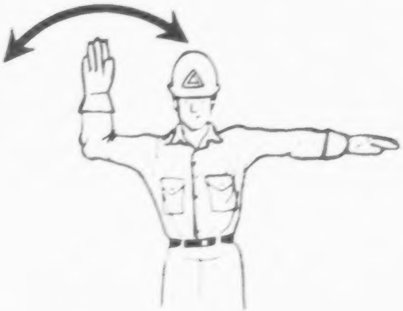
______3. Move forward



D. ______1. Turn while moving

______2. Move

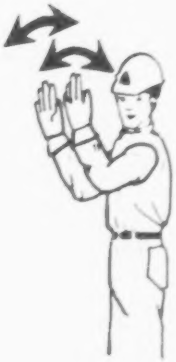
______3. Straighten out



E. ______1. Move forward

______2. Straighten out

______3. Move backward



TOOLS AND EQUIPMENT RELATED TO ALL CRAFTS
UNIT I

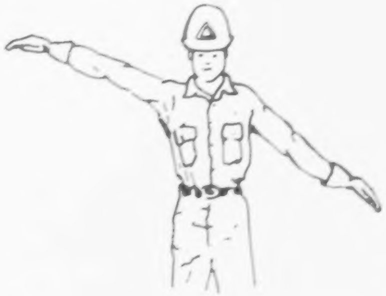
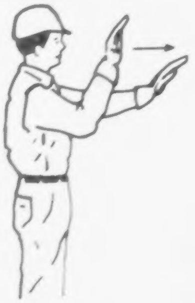
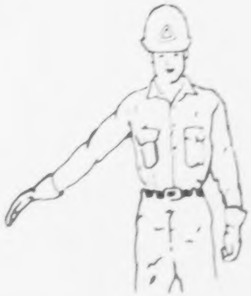
ASSIGNMENT SHEET #2 — DISTINGUISH AMONG HAND SIGNALS USED IN FORKLIFT OPERATIONS

NAME ______________________________ SCORE ______________

You should become familiar with hand signals before you need to give or receive them on the job. Practice hand signals until you are proficient at giving and receiving them.

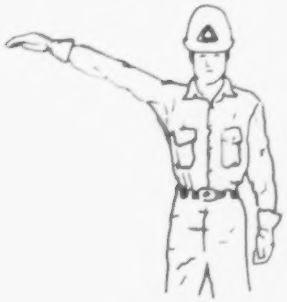
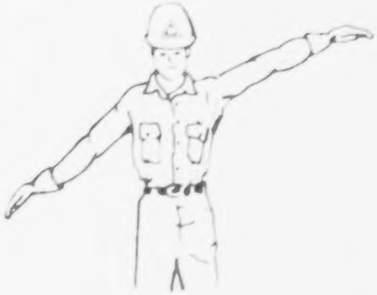
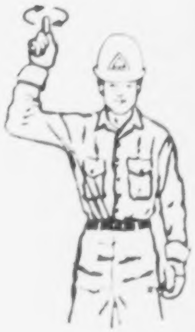
Distinguish among the following hand signals by writing an "X" in the blanks below the correct illustration.

A. Tilt forks down

1. ______________ 2. ______________ 3. ______________

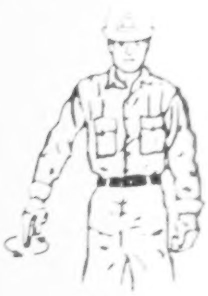
B. Tilt forks left

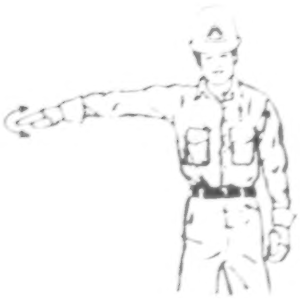




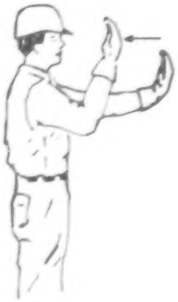
1. ______________ 2. ______________ 3. ______________

ASSIGNMENT SHEET #2

C. Lower load

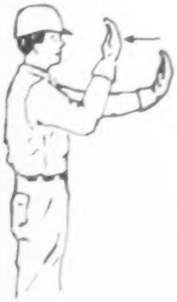


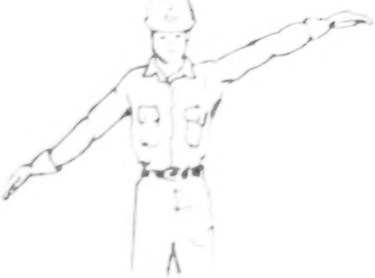


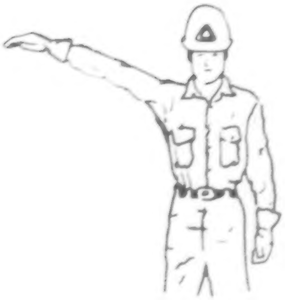


1. ______________________ 2. ______________________ 3. ______________________

D. Move load forward

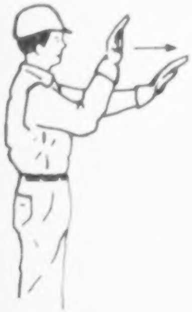


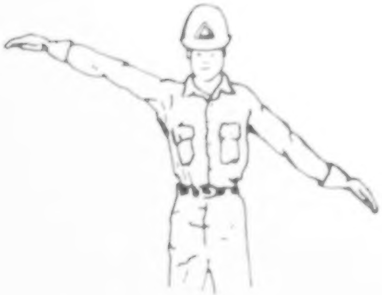


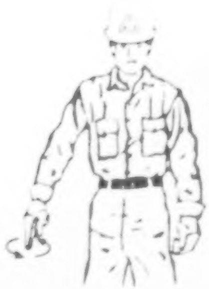


1. ______________________ 2. ______________________ 3. ______________________

E. Tilt forks right



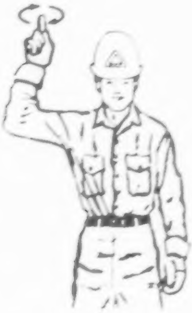


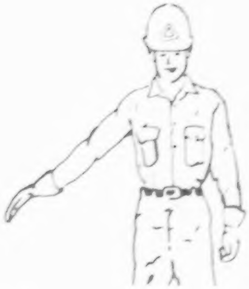


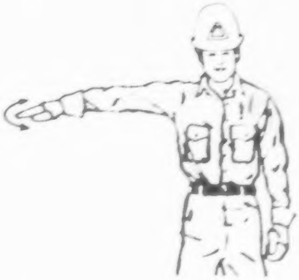
1. ______________________ 2. ______________________ 3. ______________________

ASSIGNMENT SHEET #2

F. Raise load

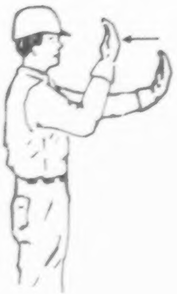


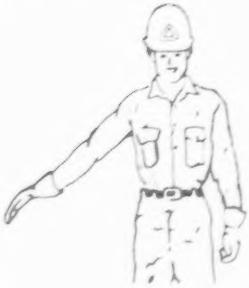


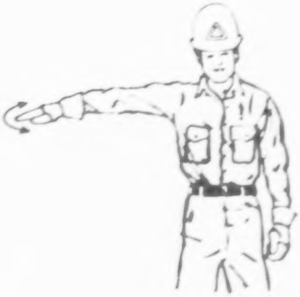


1. ______________________ 2. ______________________ 3. ______________________

G. Stop

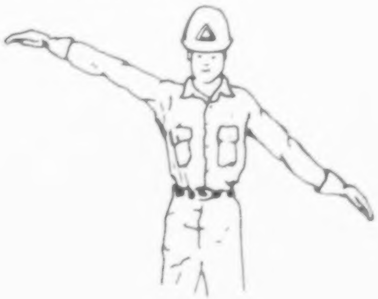


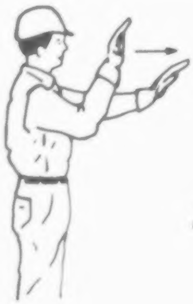


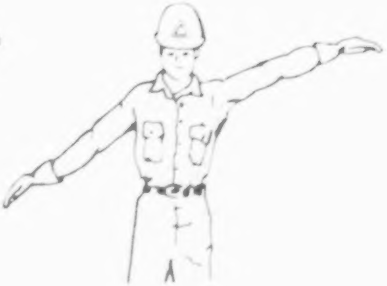


1. ______________________ 2. ______________________ 3. ______________________

H. Move load backward



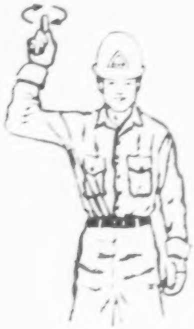


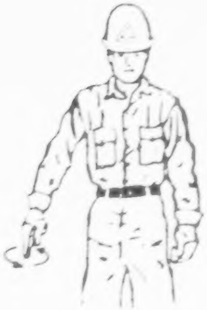


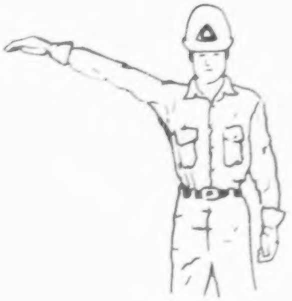
1. ______________________ 2. ______________________ 3. ______________________

ASSIGNMENT SHEET #2

I. Tilt forks up







1. ____________________ 2. ____________________ 3. ____________________

TOOLS AND EQUIPMENT RELATED TO ALL CRAFTS
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Part I	Part II
A. 2	A. 3
B. 1	B. 2
C. 3	C. 3
D. 2	D. 1
E. 1	E. 2

Assignment Sheet #2

A. 3
B. 2
C. 1
D. 1
E. 2
F. 1
G. 3
H. 2
I. 3

TOOLS AND EQUIPMENT RELATED TO ALL CRAFTS
UNIT I

TEST

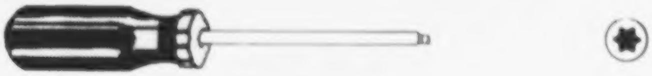
NAME ______________________________ SCORE ______________

1. Identify the following hand tools and equipment used by all crafts. Write the correct names in the blanks.

Adjustable wrench
Phillips screwdriver
Sawbuck (sawhorse)
Spade (sharpshooter)
Scoop shovel
Bench vise
Axe
Side-cut pliers
Pipe wrench
Claw hammer
Try square
Line level
Mattock

Ratchet wrench and socket
Standard screwdriver
Wrecking bar
Wheelbarrow
Sledgehammer
Metal snips
Bolt cutters
Channel-lock pliers
Spud (structural) wrench
Ball peen hammer
Combination square
Torpedo level
Utility knife

Cross peen hammer
Square-head (Robertson) screwdriver
D-handled, square-point shovel
Chalk box and line
Well pulley
Long-handled, square-point shovel
Long-handled, round-point shovel
Torx-head screwdriver
Combination slip-joint pliers
Framing square
Aluminum utility level
48-inch mason's level
Scratch awl



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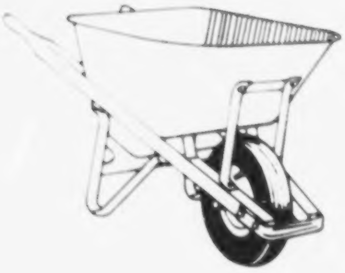
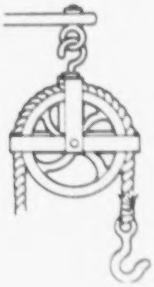
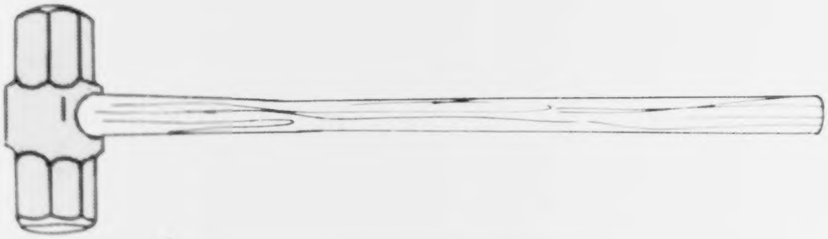


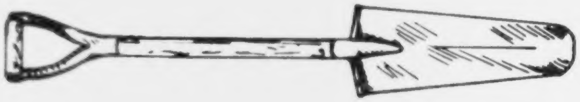


b. ______________________ c. ______________________

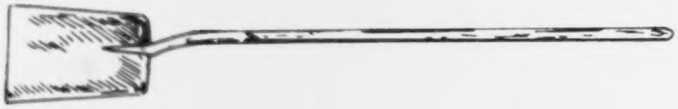
TEST



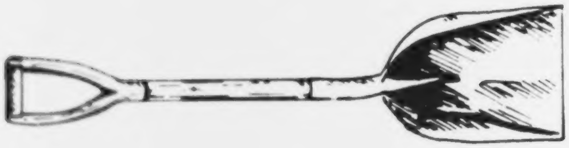
d. ______________________________



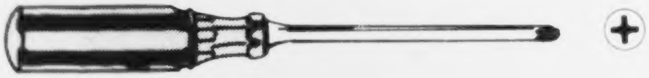
e. ______________________________



f. ______________________________

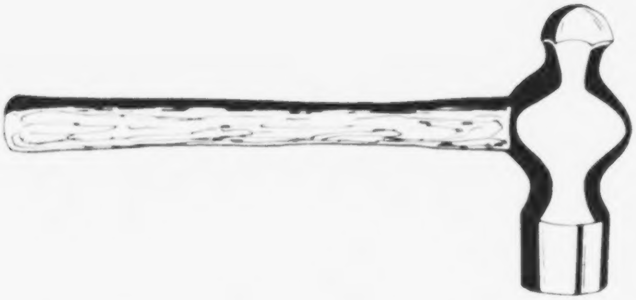


g. ______________________________

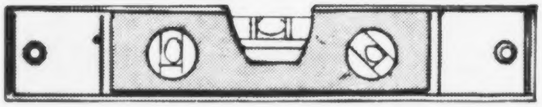


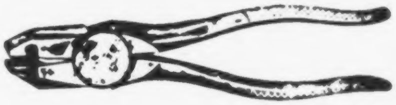
h. ______________________________

TEST



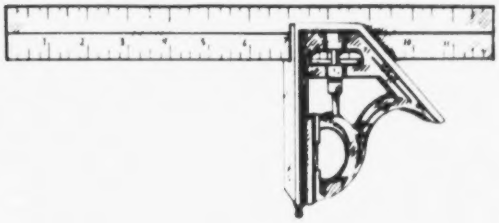
i. ______________________________

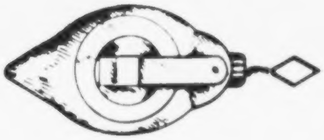




j. ______________________________

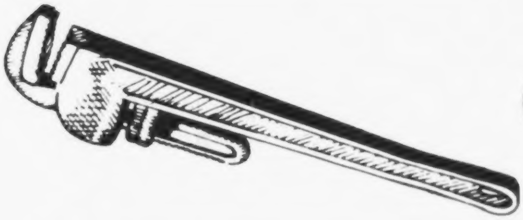
k. ______________________________

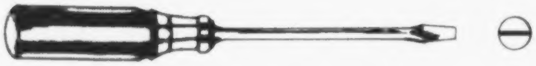




l. ______________________________

m. ______________________________

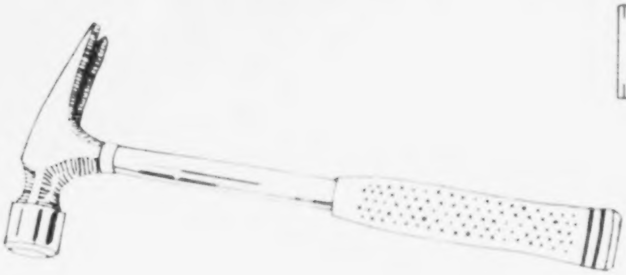


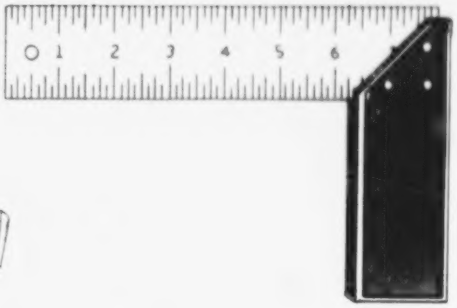


n. ______________________________

o. ______________________________

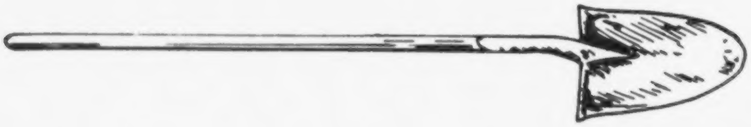
TEST



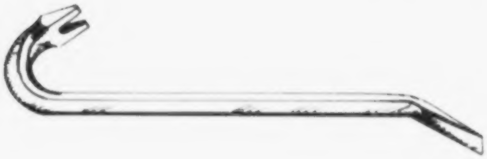


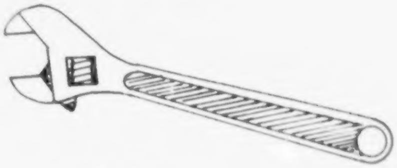
p. ____________________

q. ____________________



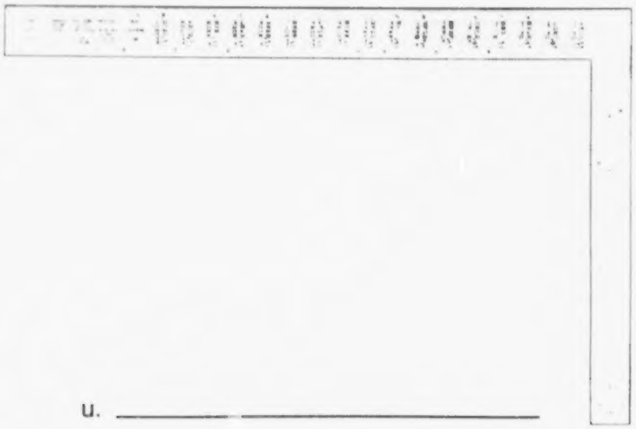
r. ____________________





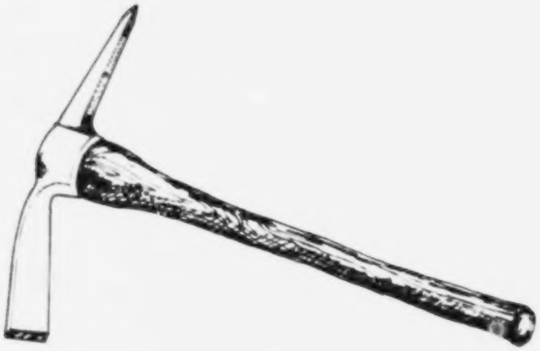
s. ____________________

t. ____________________

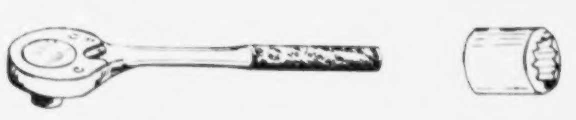


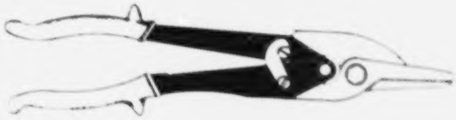
u. ____________________

TEST



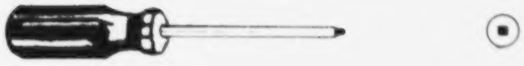
v. ________________________________

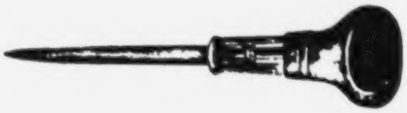




w. ________________________________

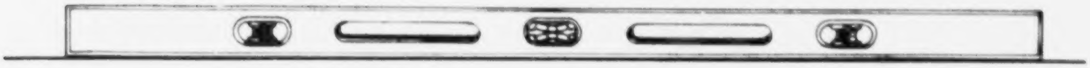
x. ________________________________





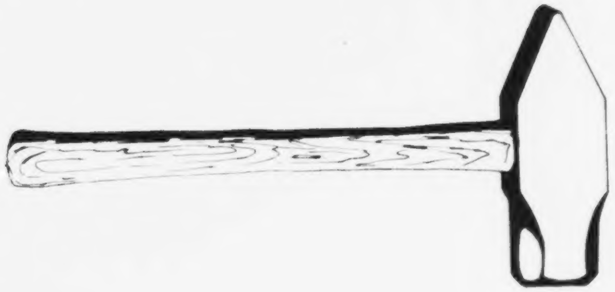
y. ________________________________

z. ________________________________

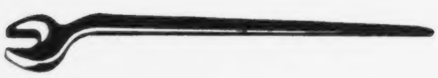


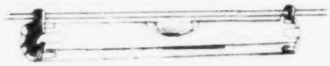
aa. ________________________________

TEST

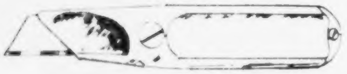


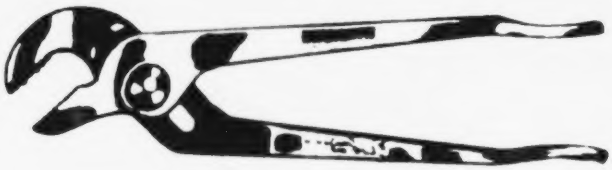
bb. ______________________________



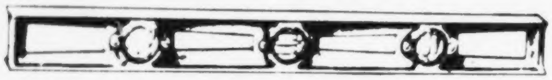


cc. ______________________________ dd. ______________________________



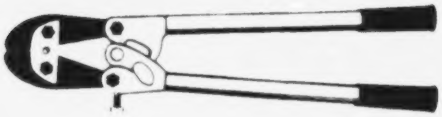


ee. ______________________________ ff. ______________________________

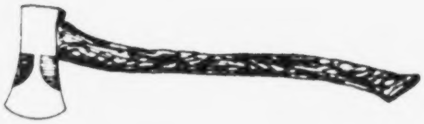


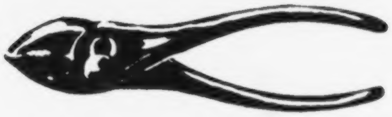
gg. ______________________________

TEST

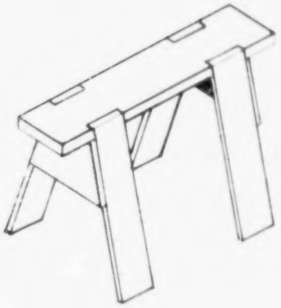


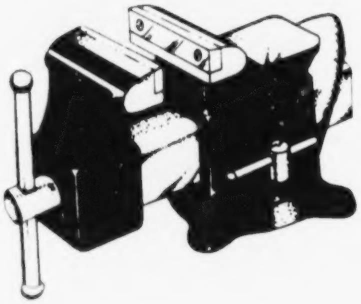
hh. ______________________________ ii. ______________________________





jj. ______________________________ kk. ______________________________



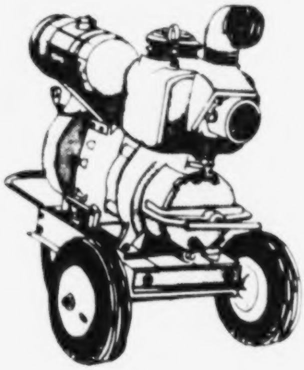


ll. ______________________________ mm. ______________________________

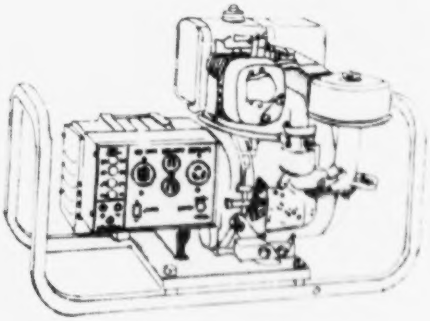
TEST

2. Identify the following power tools and equipment used by all crafts. Write the correct names in the blanks

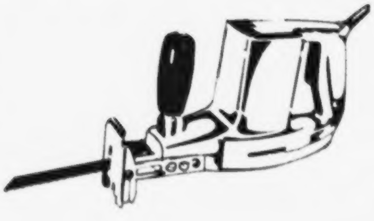
Band saw
¼-inch hand drill
½-inch hand drill
Chain saw
Drill press
Alternator
Bend grinder
Powder-actuated tool
Portable angle grinder
Space heater
Reciprocating saw
Gasoline air compressor
Water pump
Vacuum cleaner and accessories
Electric percussion hammer
Portable electric hammer
Air compressor and paving breaker
Power lift
Rotary hammer



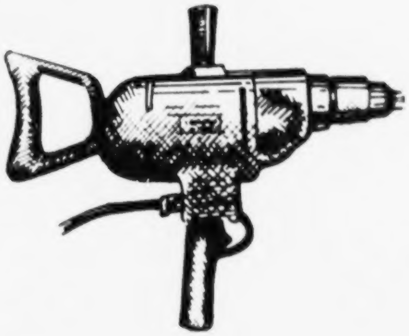
a. ______________________________



b. ______________________________

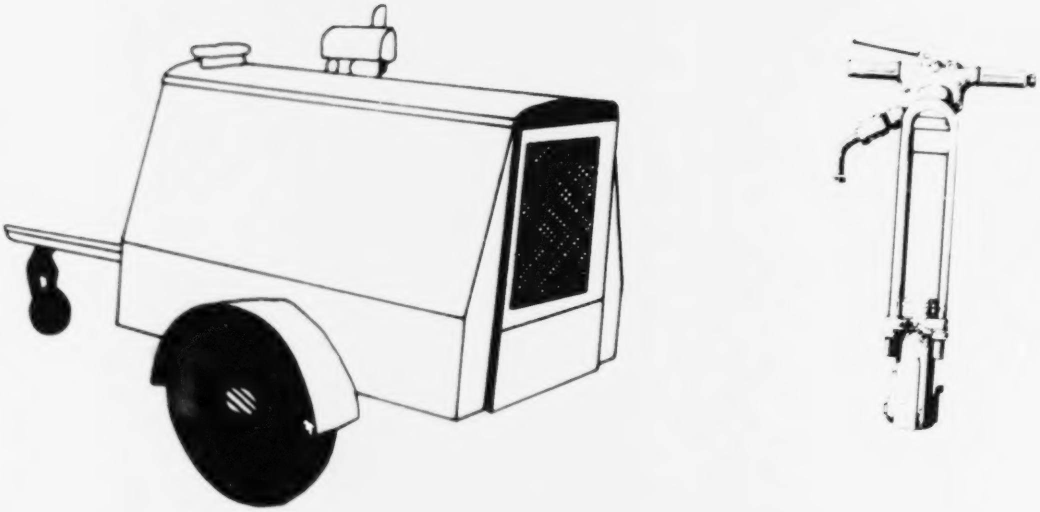


c. ______________________________

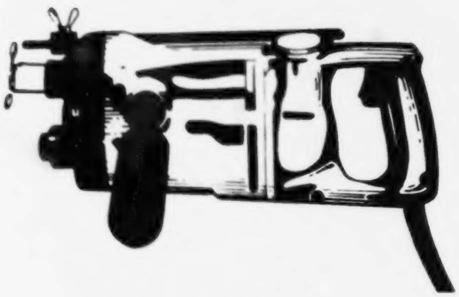


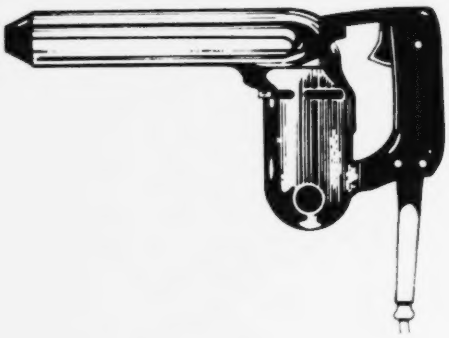
d. ______________________________

TEST



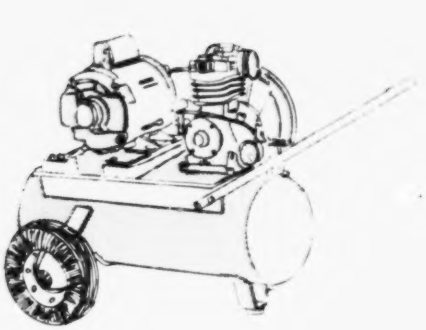
e. ____________________



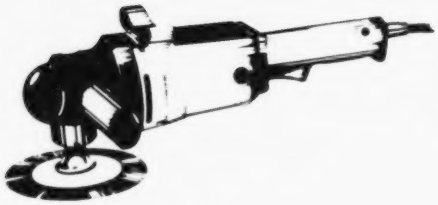


f. ____________________ g. ____________________

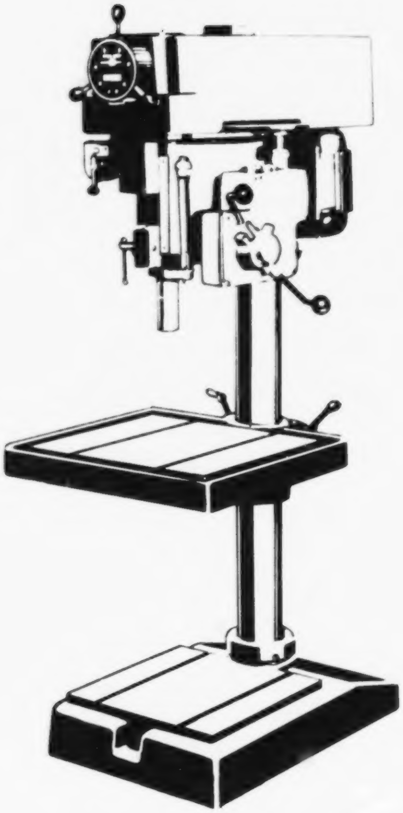
TEST



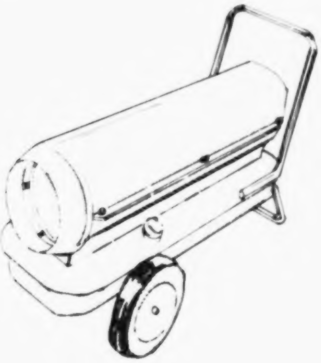
h. ______________________________



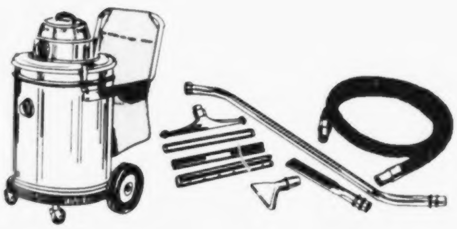
i. ______________________________



j. ______________________________

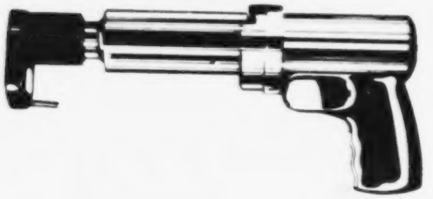


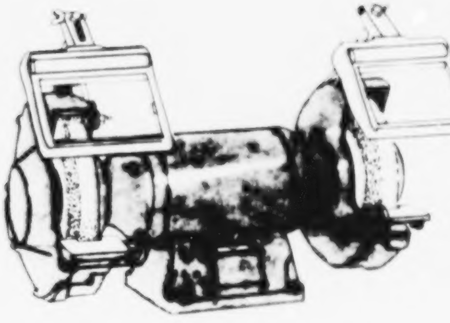
k. ______________________________



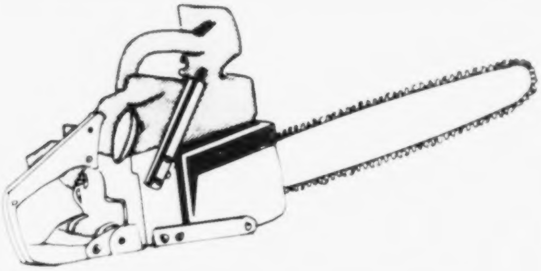
l. ______________________________

TEST

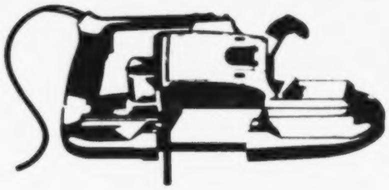




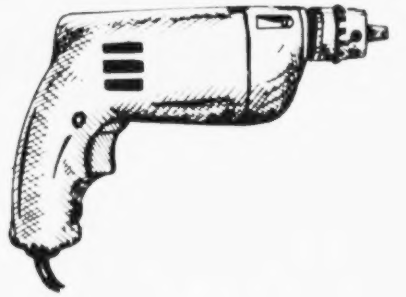
m. ______________________________ n. ______________________________

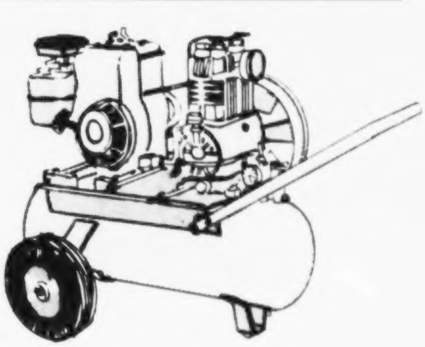


o. ______________________________



p. ______________________________ q. ______________________________



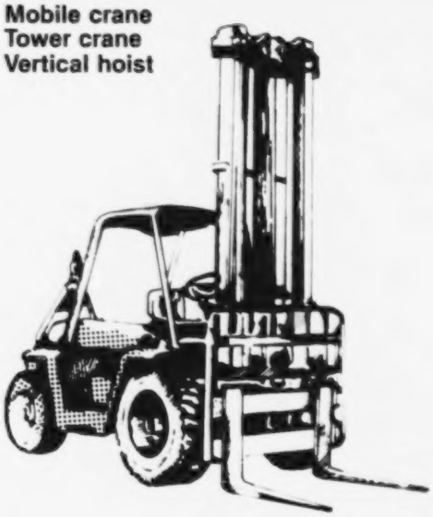


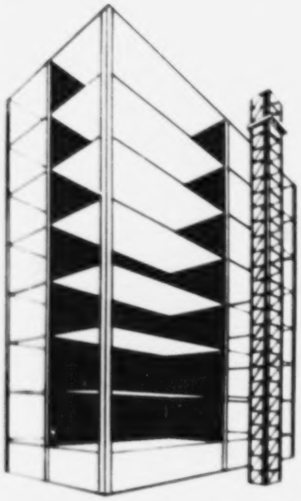
r. ______________________________ s. ______________________________

TEST

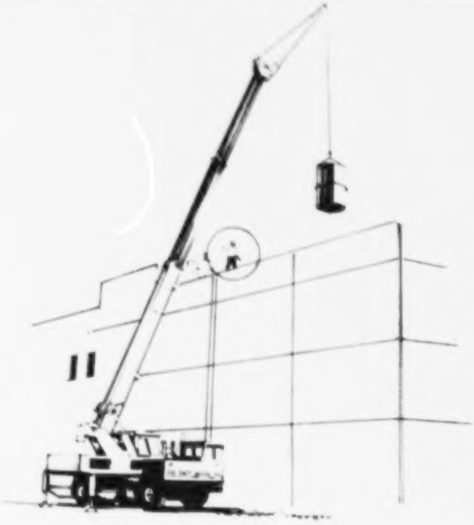
3. Identify the following equipment used for specific construction jobs. Write the correct names in the blanks.

Mobile crane
Tower crane
Vertical hoist
Power buggy
Forklift
Conveyor



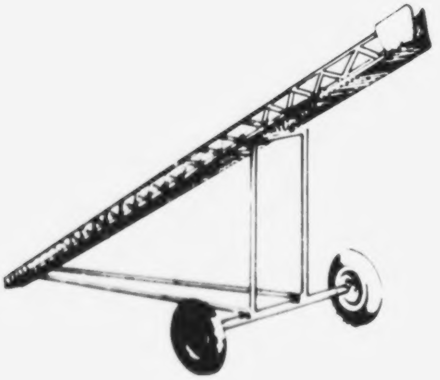


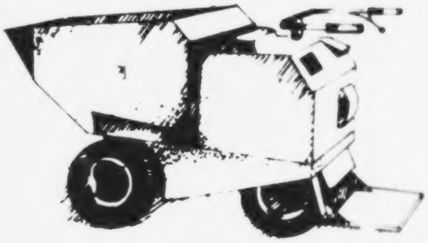
a. ______________________________ b. ______________________________



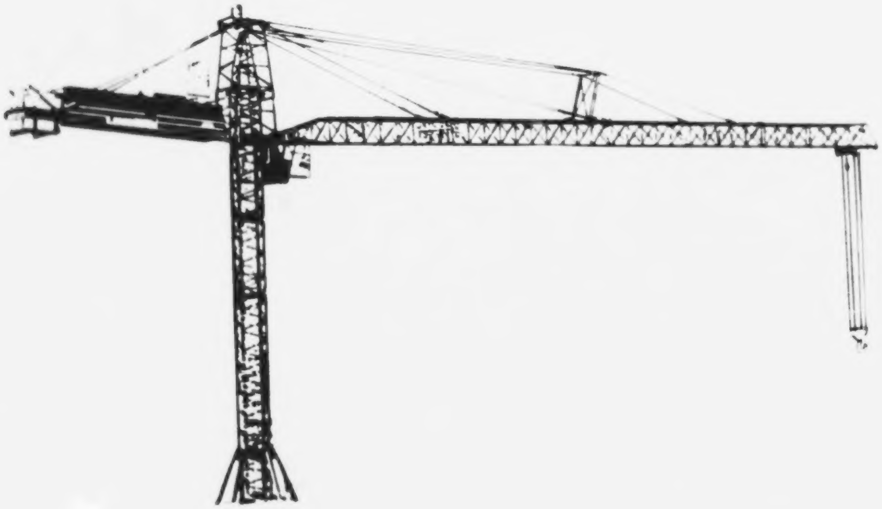
c. ______________________________

TEST





d. ______________________________ e. ______________________________



f. ______________________________

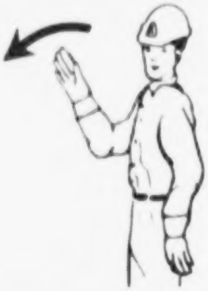
TEST

4. Distinguish among the following hand signals used in maneuvering operations. Write an "X" in the correct blanks.

a. _____1. Move forward

_____2. Turn while moving

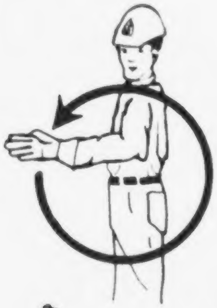
_____3. Straighten out



b. _____1. Straighten out

_____2. Turn while moving

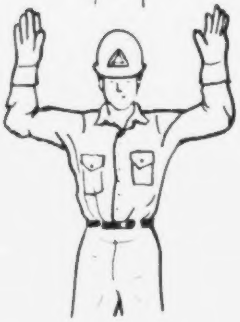
_____3. Move



c. _____1. Move

_____2. Stop

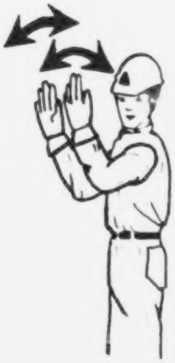
_____3. Turn



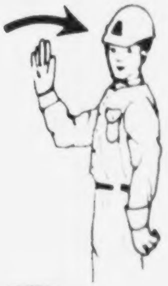
d. _____1. Move forward

_____2. Stop

_____3. Straighten out



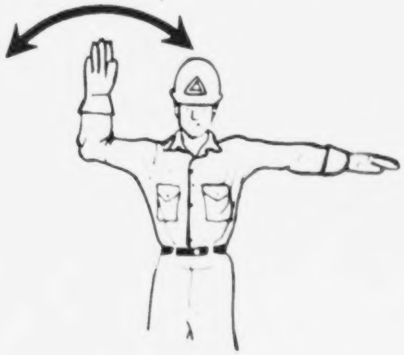
TEST



e. ______1. Straighten out

______2. Move backward

______3. Move

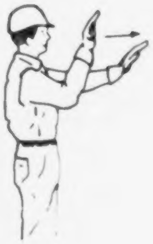


f. ______1. Turn while moving

______2. Stop

______3. Move forward

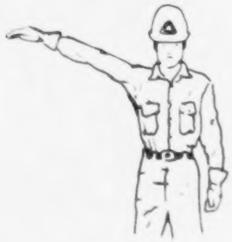
5. Distinguish among the following hand signals used in forklift operations. Write an "X" in the correct blanks.



a. ______1. Move load forward

______2. Move load backward

______3. Lower load



b. ______1. Tilt forks up

______2. Tilt forks right

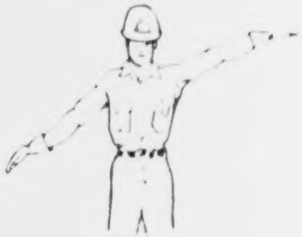
______3. Move load right

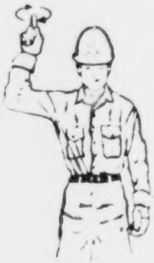
TEST

c. ______1. Tilt forks down

______2. Tilt forks left

______3. Tilt forks up





d. ______1. Stop

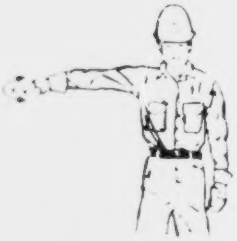
______2. Move load

______3. Raise load

e. ______1. Stop

______2. Raise load

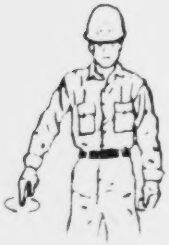
______3. Lower load



f. ______1. Stop

______2. Tilt forks down

______3. Lower load

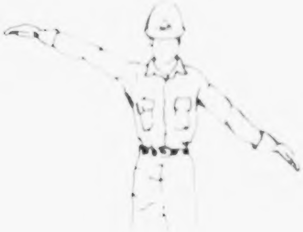


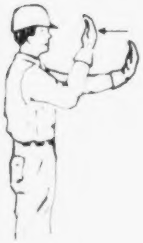
TEST

g. ______1. Raise load

______2. Tilt forks right

______3. Lower load

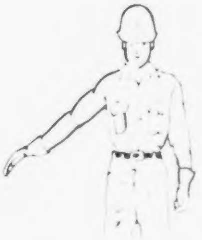




h. ______1. Move load forward

______2. Stop

______3. Turn left



i. ______1. Tilt forks down

______2. Tilt forks right

______3. Move right

TOOLS AND EQUIPMENT RELATED TO ALL CRAFTS
UNIT I

ANSWERS TO TEST

1.
   a. Torx-head screwdriver
   b. Wheelbarrow
   c. Well pulley
   d. Sledgehammer
   e. Spade
   f. Long-handled, square-point shovel
   g. Scoop shovel
   h. Phillips screwdriver
   i. Ball peen hammer
   j. Torpedo level
   k. Side-cut pliers
   l. Combination square
   m. Chalk box and line
   n. Pipe wrench
   o. Standard screwdriver
   p. Claw hammer
   q. Try square
   r. Long-handled, round-point shovel
   s. Wrecking bar
   t. Adjustable wrench
   u. Framing square
   v. Mattock
   w. Ratchet wrench and socket
   x. Metal snips
   y. Square-head (Robertson) screwdriver
   z. Scratch awl
   aa. 48-inch mason's level
   bb. Cross peen hammer
   cc. Spud (structural) wrench
   dd. Line level
   ee. Utility knife
   ff. Channel-lock pliers
   gg. Aluminum utility level
   hh. Bolt cutters
   ii. D-handled, square-point shovel
   jj. Axe
   kk. Combination slip-joint pliers
   ll. Sawbuck
   mm. Bench vise

2.
   a. Water pump
   b. Alternator
   c. Reciprocating saw
   d. $^1/_2$-inch hand drill
   e. Air compressor and paving breaker
   f. Rotary hammer
   g. Electric percussion hammer
   h. Electric air compressor
   i. Portable angle grinder
   j. Drill press
   k. Space heater
   l. Vacuum cleaner and accessories
   m. Powder-actuated tool
   n. Bench grinder
   o. Chain saw
   p. Band saw
   q. Power lift
   r. $^1/_4$-inch hand drill
   s. Gasoline air compressor

3.
   a. Forklift
   b. Vertical hoist
   c. Mobile crane
   d. Conveyor
   e. Power buggy
   f. Tower crane

4.
   a. 1
   b. 3
   c. 2
   d. 3
   e. 2
   f. 1

ANSWERS TO TEST

5. a. 2
   b. 1
   c. 2
   d. 3
   e. 1
   f. 3
   g. 2
   h. 1
   i. 1

LADDERS AND SCAFFOLDS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to identify different types of ladders and scaffolds and should be able to set up a section of scaffolding. The student will show this knowledge by completing job sheet and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with ladders and scaffolds.
2. Identify types of ladders and scaffolds.
3. Identify parts of a prefabricated rolling scaffold.
4. State safety precautions for ladders and scaffolds.
5. Demonstrate the ability to set up a section of scaffold.

LADDERS AND SCAFFOLDS
UNIT II

SUGGESTED ACTIVITIES

I. Unit content

A. Objective sheet

B. Suggested activities

C. Supplement #1 — Ladder and Scaffold Crossword Puzzle

D. Transparency masters

1. Transparency #1 — Ladder Safety

2. Transparency #2 — Ladder Danger

E. Information sheet

F. Job Sheet #1 — Set Up a Section of Scaffold

G. Test

H. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Competency profiles

(NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364 and from The Associated General Contractors of America, 1957 E Street Northwest, Washington, DC 20006, phone 202/393-2040.)

2. Copies of Supplement #1

3. Posters of ladder and scaffold safety

4. Filmstrips and cassettes — *Ladders and Scaffolding*, available from Career Aids, Inc., 20417 Nordhoff Street, Department K4, Chatsworth, CA 91311.

SUGGESTED ACTIVITIES

C. Introduce unit to students.

- Discuss ladders and scaffolds, proper setup, and assembly.
- Discuss and emphasize the importance of observing proper safety precautions pertaining to ladders and scaffolds.

D. Provide students with information and job sheets.

E. Discuss information and job sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with ladders and scaffolds.
    - Point out the importance of defining terms for common understanding.
    - Have students review terms by completing Supplement #1, "Ladder and Scaffold Crossword Puzzle."
2. Use Information Sheet, Sections II and III, to discuss the different types of ladders and scaffolds and the parts of a prefabricated scaffold.
    - Take a field trip to a construction site to see how some of the ladders and scaffolds in this unit are being used.
    - Make a set of flash cards containing pictures of ladders and scaffolds. Show students flash cards. Have them identify the pictures and write their answers on a sheet of paper.
    - Visually check ladders and scaffolds on the job site to see if they are all sound and safe to use.
3. Use Information Sheet, Section IV, to discuss safety precautions pertaining to ladders and scaffolds.
    - Show safety filmstrip *Ladders and Scaffolding*.
    - Use Transparencies #1 and #2 to emphasize ladder safety.
    - Have students survey the community to determine where ladders and scaffolds are being used; have them take pictures of them in use.
    - Have students check ladders that they may have at home, at friends' or relatives' homes to see if they are in safe condition to use.
    - Have students demonstrate correct safety precautions for ladders and scaffolds to the class.
    - Have each student demonstrate correct method of setting up ladders.

SUGGESTED ACTIVITIES

4. Use Job Sheet #1 to discuss setting up a scaffold.

    - Lay out parts of a prefabricated scaffold. Have students identify the parts, then explain how they go together.

    - Demonstrate procedures as outlined in Job Sheet #1. Have students demonstrate procedures, then have students complete Job Sheet #1.

F. Give test.

G. Critique test and discuss it in class.

H. Reteach and retest if necessary.

I. Complete appropriate section of competency profiles.

III. Unit reference — Hendrix, Laborn J., "Bud." *Fundamentals of Carpentry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1985.

LADDERS AND SCAFFOLDS
UNIT II

SUPPLEMENT #1 — LADDER AND SCAFFOLD CROSSWORD PUZZLE

How well do you remember the information in the unit? Test yourself by using the following clues to work the crossword puzzle on the next page. Work as much of it as possible without referring to your Information Sheet. If you get stumped, check the Information Sheet for terms you did not recall; and then finish the puzzle.

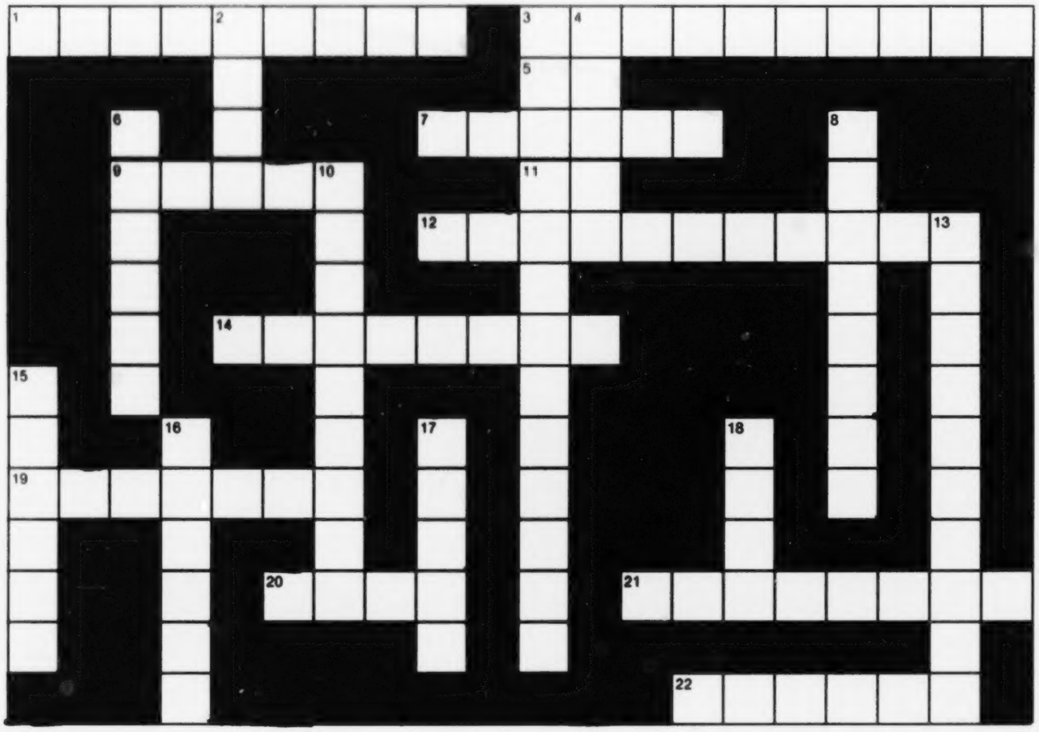
ACROSS

1. Type of ladder
3. Type of ladder
5. Abbreviation for *church*
7. Any small member used primarily to support another member or structure
9. A representative
11. Abbreviation for *iron*
12. Guardrails attached on scaffolds about 42 inches high and midway between 42 inches and toeboard (2 wds)
14. Type of scaffold that is constructed and set up on the site where it is to be used
19. Type of scaffold used for curved or irregular shapes
20. Federal legislation designed to ensure safe and sanitary working conditions for employees (abbr)
21. Type of ladder
22. Another name for 21. across

DOWN

2. Not one
3. Angle-shaped devices manufactured to fasten on forms in pairs to support a platform for workers and materials (2 wds)
4. Minimum number of feet a ladder should extend above its top support
6. Wheel used to support scaffold; mounted in a swivel frame and usually furnished with brakes
8. Another name for *stage scaffold*
10. Four-inch guardrails attached ¼ inch above scaffold platform to prevent tools and materials from falling from scaffold
13. Safety device on bottom of ladders; used to prevent ladder heel from sliding (2 wds)
15. Short member on which the scaffold planks or platform is laid and attached
16. Wooden support on ground under scaffold
17. Board nailed to the bottom of the scaffold planks to hold them together and to keep them from sliding off the end frames
18. For a ladder to be at a safe angle from its support, the ratio of distance from ladder to base of support to the height of top support is one to ____________

SUPPLEMENT #1


1
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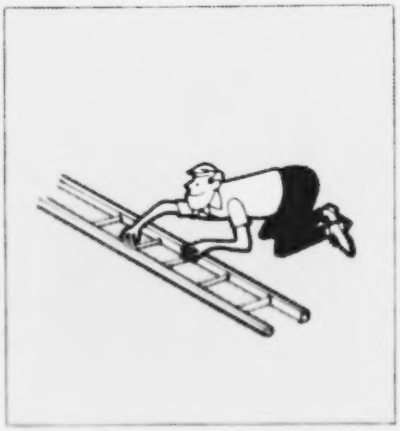
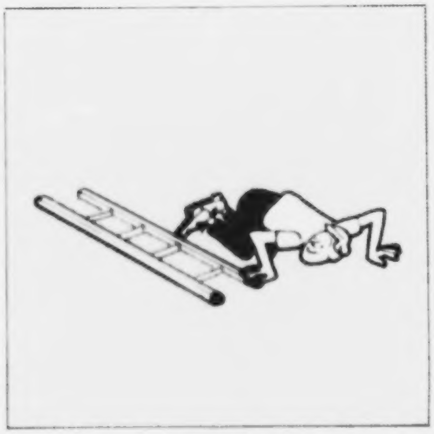
SUPPLEMENT #1

1 E	X	T	E	2 N	S	I	O	N		3 S	4 T	E	P	L	A	D	D	E	R
				O						5 C	H								
		6 C		N				7 B	E	A	R	E	R			8 S			
		9 A	G	E	N	10 T				11 F	E					W			
		S				O		12 S	A	F	E	T	Y	R	A	I	L	13 S	
		T				E				O						N		A	
		E		14 J	O	B	B	U	I	L	T					G		F	
15 P		R				O				D						I		E	
U			16 M			A		17 C		J				18 F		N		T	
19 T	U	B	U	L	A	R		L		A				O		G		Y	
L			D			D		E		C				U				S	
O			P		20 O	S	H	A		K		21 S	T	R	A	I	G	H	T
G			A					T		S								O	
			D										22 S	I	N	G	L	E	

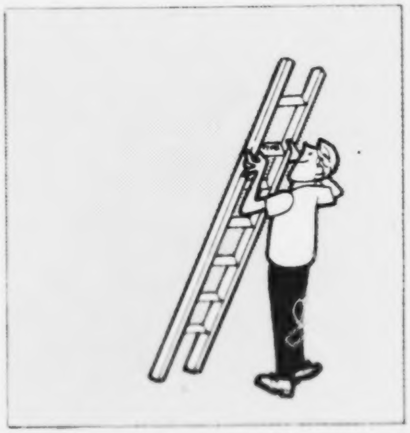
Ladder Safety



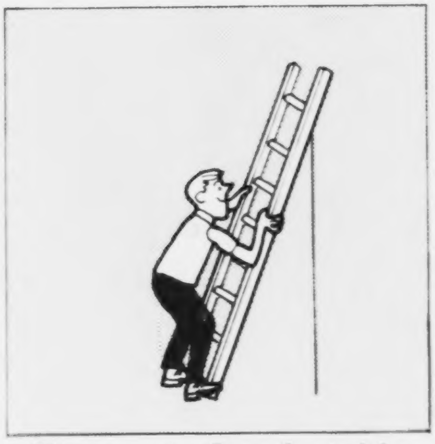
Check Condition



Check Safety Shoes



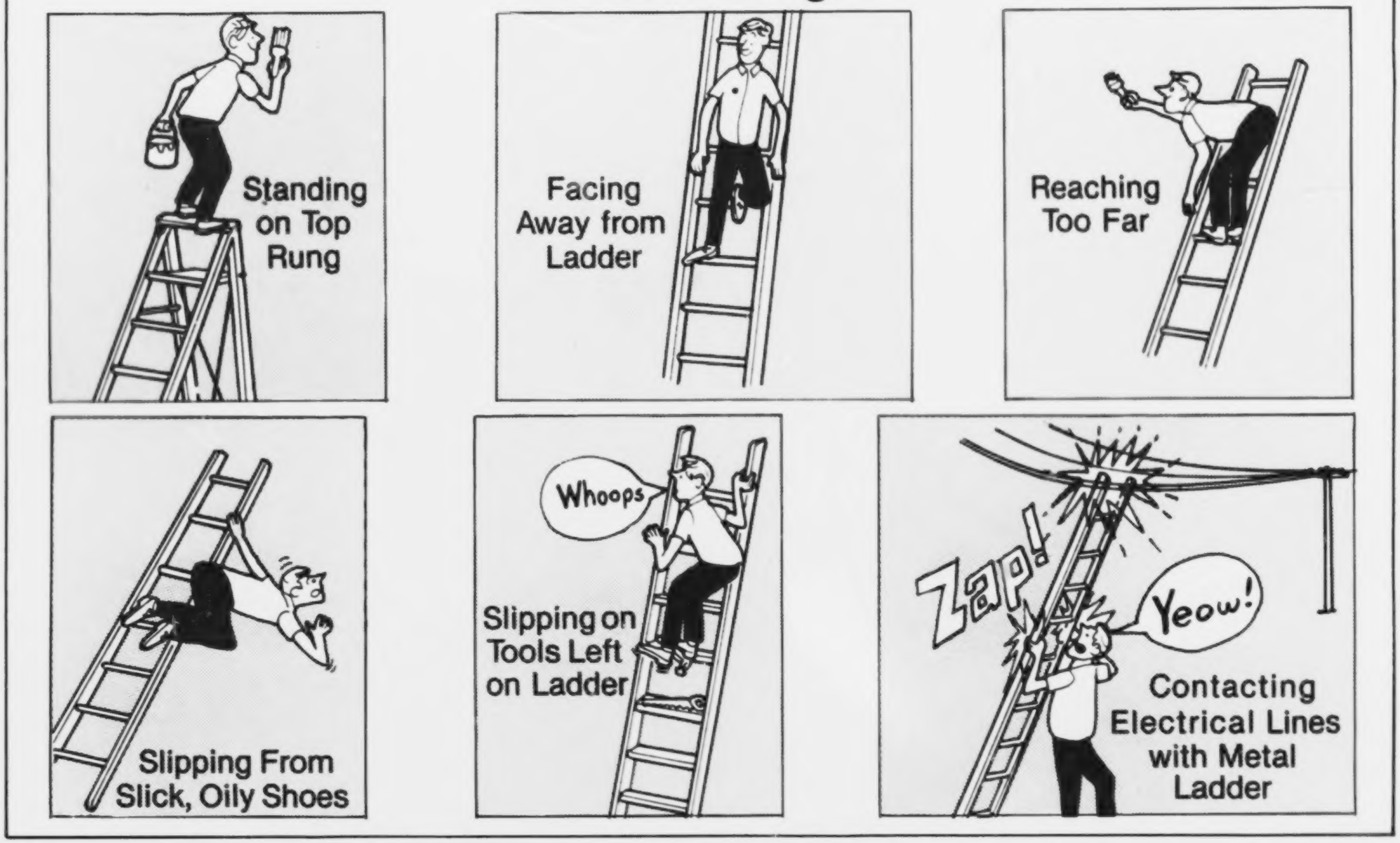
Check Load Limit



Place at Comfortable Angle

Adapted with permission of American Association for Vocational Instructional Materials, Athens, Georgia, from *Developing Shop Safety Skills* by Clinton O. Jacobs and J. Howard Turner, 1981.

Ladder Danger


Standing on Top Rung
Facing Away from Ladder
Reaching Too Far
Slipping From Slick, Oily Shoes
Whoops
Slipping on Tools Left on Ladder
Zap!
Yeow!
Contacting Electrical Lines with Metal Ladder

Adapted with permission of American Association for Vocational Instructional Materials, Athens, Georgia, from *Developing Shop Safety Skills* by Clinton O. Jacobs and J. Howard Turner, 1981.

LADDERS AND SCAFFOLDS
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. **Bearer** — Any small member used primarily to support another member or structure

B. **Caster** — Wheel used to support scaffold; mounted in a swivel frame and usually furnished with brakes

C. **Cleat** — Board nailed to the bottom of the scaffold planks to hold them together and to keep them from sliding off the end frames

D. **Job-built scaffold** — Scaffold that is constructed and set up on the site where it is to be used

E. **Mudpads** — Heavy pieces of wood nailed together to form pads about 18 inches square; used on ground to support scaffolds

F. **OSHA (Occupational Safety and Health Act)** — Federal legislation designed to ensure safe and sanitary working conditions for employees

G. **Putlog** — Short member on which the scaffold planks or platform is laid and attached

H. **Safety shoe** — Safety device on bottom of ladders; used to prevent ladder heel from sliding

I. **Safety rails** — Guardrails attached on scaffolds about 42 inches high and midway between 42 inches and toeboard

J. **Scaffold jacks** — Angle-shaped devices manufactured to fasten on forms in pairs to support a platform for workers and material

K. **Swinging scaffold (stage)** — Type of scaffold normally hung from top of a structure for which it is not practical to build a scaffold

L. **Tagline** — Rope used to guide or steady a load being hoisted

M. **Toeboards** — Four-inch guardrails attached 1/4 inch above scaffold platform to prevent tools and material from falling from scaffold

INFORMATION SHEET

II. Types of ladders and scaffolds used by all crafts

A. Ladders (Figures 1-3)

(NOTE: Ladders may be wood, metal, or fiberglass. Maintain caution when using metal ladders near any electrical wires or equipment.)

1. Stepladder
2. Extension
3. Single, straight

FIGURE 1

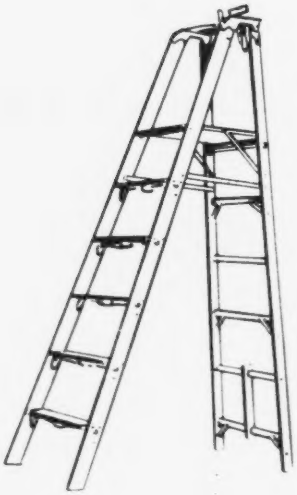


FIGURE 2

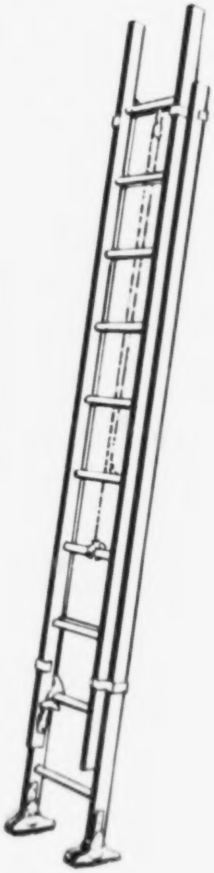
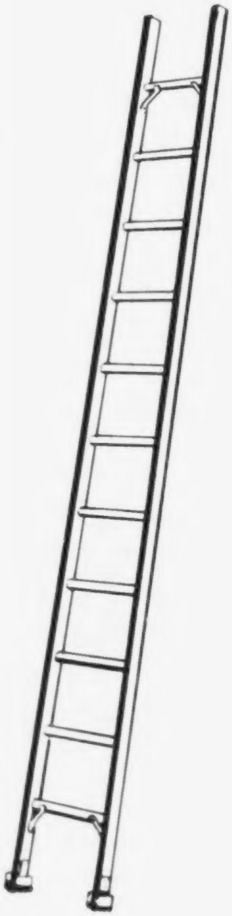


FIGURE 3



INFORMATION SHEET

B. Scaffolds

(NOTE: Scaffolds may be wood, steel, or aluminum; they may be prefabricated or built at the job site.)

1. Prefabricated (Figures 4-6)

FIGURE 4

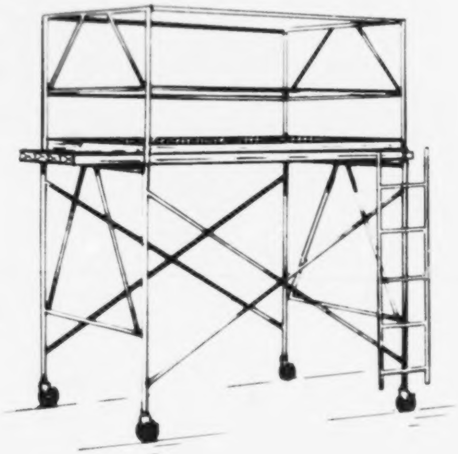


FIGURE 5

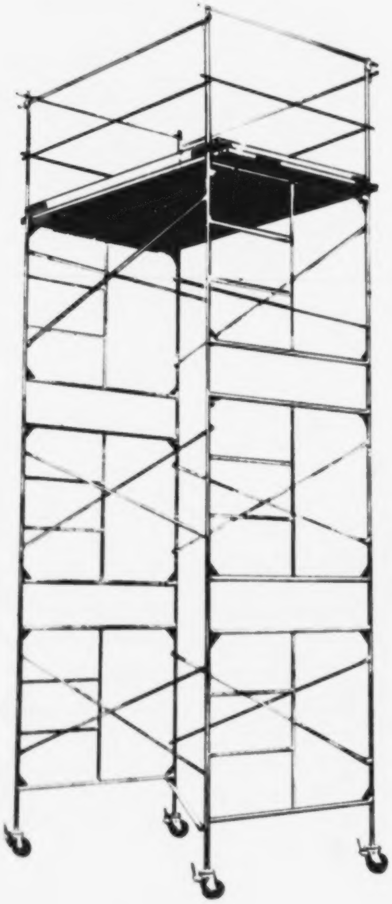
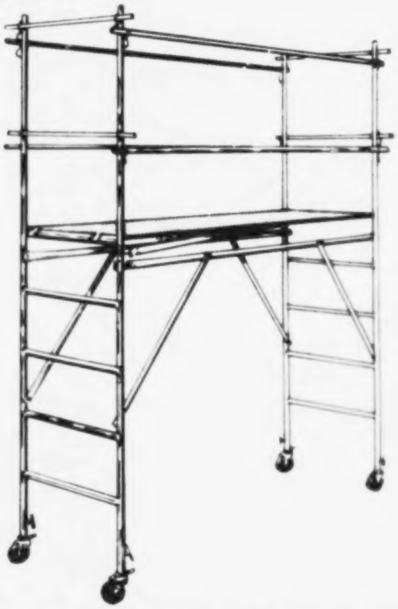
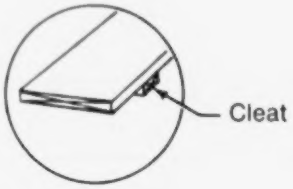


FIGURE 6





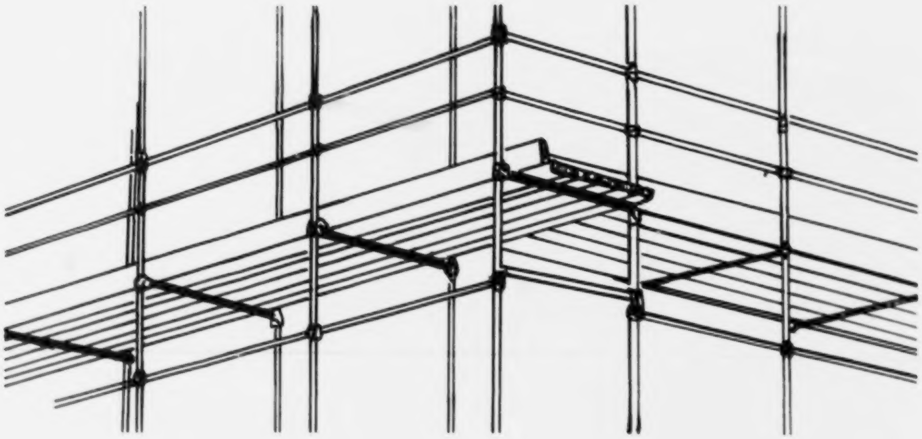
Figures 5 and 6 used with permission of Deal Products, Palmer, Pennsylvania.

INFORMATION SHEET

2. Tubular, locking (Figure 7)

   (NOTE: This type of scaffolding can be used with curved or irregular shapes such as cylinders, spheres, and pyramids.)

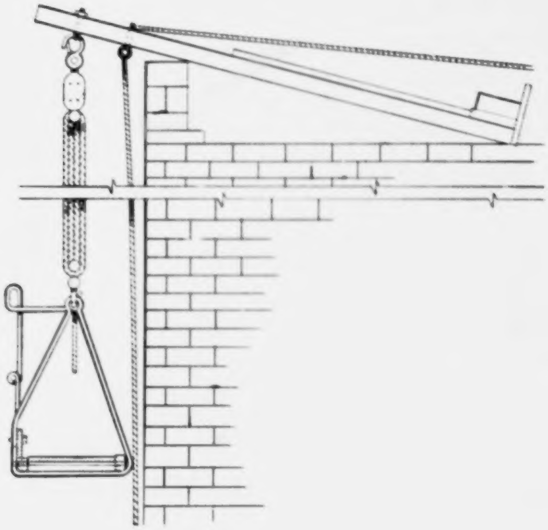
FIGURE 7



Used with permission of Patent Scaffolding Company, Fort Lee, New Jersey.

3. Swinging (Figure 8)

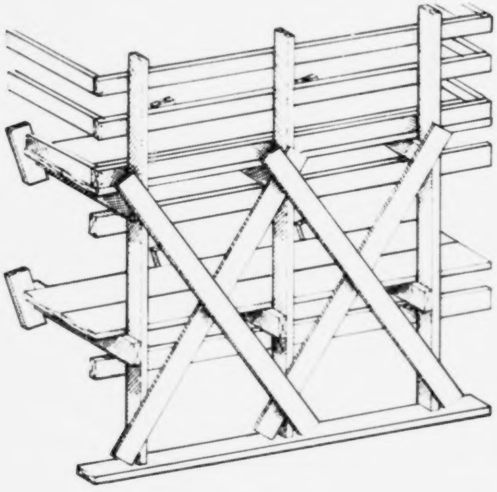
FIGURE 8



INFORMATION SHEET

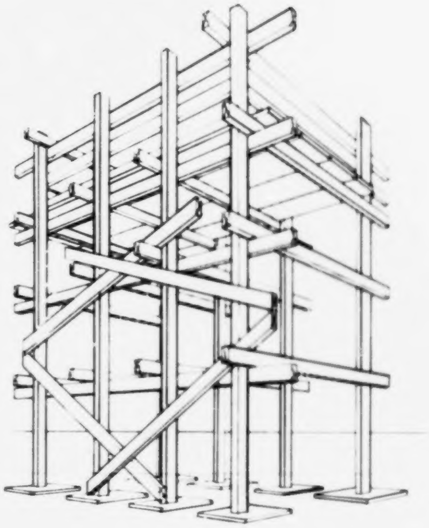
4. Single-pole (Figure 9)

FIGURE 9



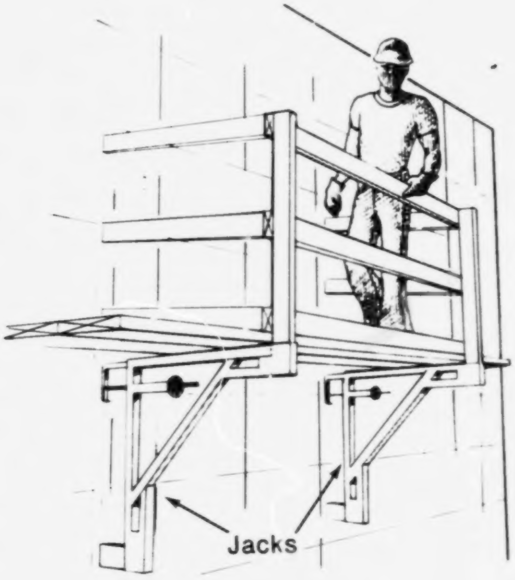
5. Double-pole (Figure 10)

FIGURE 10



6. Scaffold jacks with platform (Figure 11)

FIGURE 11

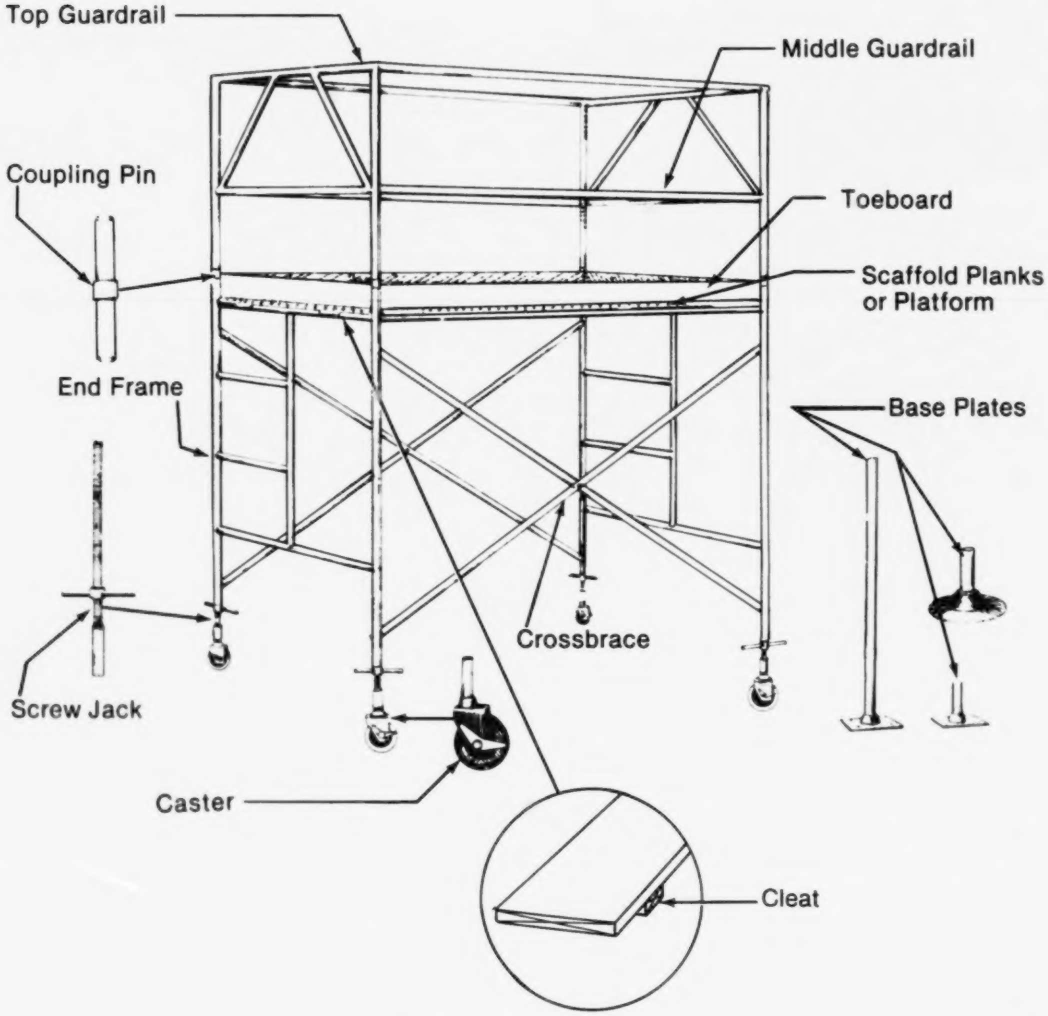


INFORMATION SHEET

III. Parts of a prefabricated rolling scaffold (Figure 12)

(NOTE: OSHA requires a top guardrail approximately 42 inches high, a midrail halfway between top guardrail and toeboard, and a toeboard just above the scaffold plank or platform.)

FIGURE 12


Top Guardrail
Middle Guardrail
Coupling Pin
Toeboard
Scaffold Planks or Platform
End Frame
Base Plates
Crossbrace
Screw Jack
Caster
Cleat

INFORMATION SHEET

IV. Safety precautions for ladders and scaffolds

A. Scaffolding

1. Always check for electrical wires; deenergize them before erecting metal scaffolding in the vicinity
2. Be sure that wheels are locked on rolling scaffolds before ascending
3. Do not work on scaffolds during storms, high winds, or when scaffolds are covered with ice or snow
4. Tie off scaffolds about every 25 feet when they are built several sections high
5. Do not overload scaffolds
6. Be sure that scaffolds are equipped with top rail (42 inches high), midrail, and toeboard
7. Be sure that scaffold boards have cleats when necessary
8. Use safety belts, harness, and nets as required

B. Ladders

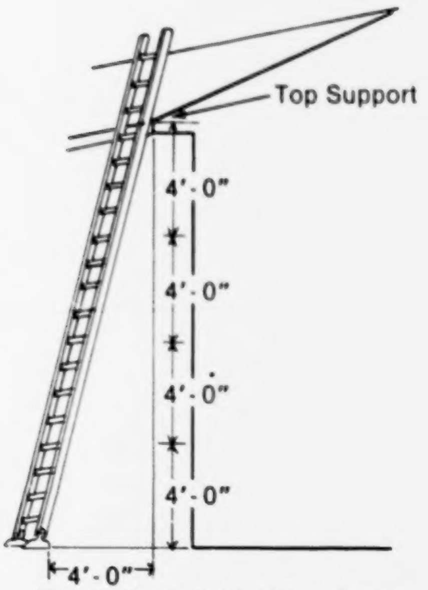
1. Fully spread and lock any stepladder before using
2. Do not use ladders that are not equipped with safety shoes
3. Never overreach from a ladder
4. Never work from the top step of any ladder
5. Never use a metal ladder when there is any possibility of contact with electrical conductors
6. Never use ladders in a horizontal position
7. Do not climb on a ladder that is occupied by someone else
8. Remove ladder when you are finished using it, and always remove and store ladder at end of workday

INFORMATION SHEET

9. Place ladders approximately one-quarter of their support length away from vertical plane of top support, and extend ladders at least 3 feet above top support (Figures 13 and 14)

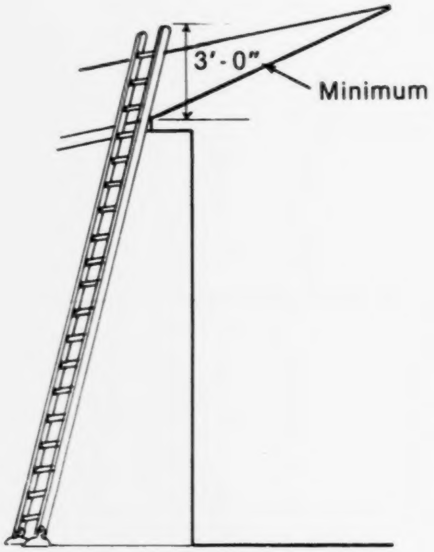
EXAMPLES:

FIGURE 13



One-Fourth the Height of Top Support

FIGURE 14



10. Secure ladders at both top and bottom to prevent displacement; brace long ladders at intermediate points to prevent spring

LADDERS AND SCAFFOLDS
UNIT II

JOB SHEET #1 — SET UP A SECTION OF SCAFFOLD

I. Equipment

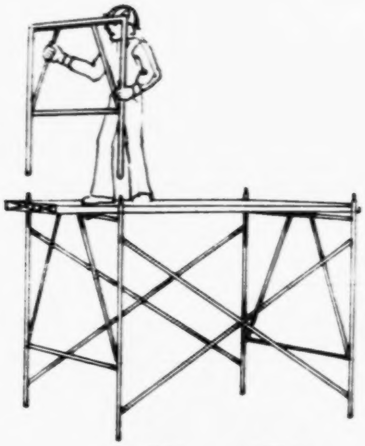
- A. Two end frames
- B. Two safety rail end frames
- C. Two crossbraces
- D. Two scaffold planks

  (NOTE: Be sure that planks have safety cleats.)
- E. Four guardrails
- F. Four toeboards
- G. Four coupling pins
- H. Four casters
- I. Ladder section

II. Procedure

- A. Secure crossbraces to one end frame
- B. Secure crossbraces to second end frame
- C. Set scaffold planks on end frames, safety cleats facing down
- D. Set coupling pins in both end frames
- E. Lift safety rail end frames to scaffold planks
- F. Climb to scaffold planks, and set one safety rail end frame over coupling pins (Figure 15)

FIGURE 15



JOB SHEET #1

G. Set second end frame over remaining coupling pins

H. Secure toeboards to uprights

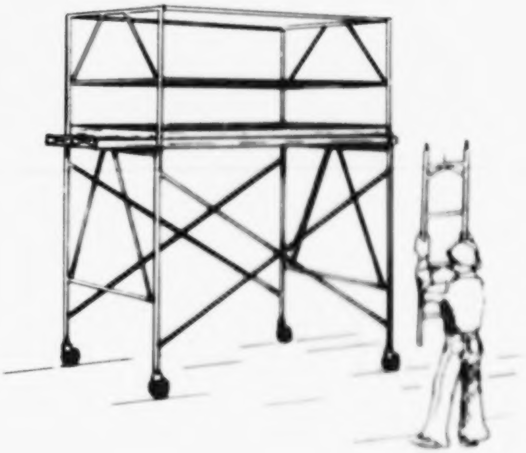
I. Secure guardrails

J. Lift one end of scaffold and insert casters; set brakes

K. Lift opposite end of scaffold and insert casters; set brakes

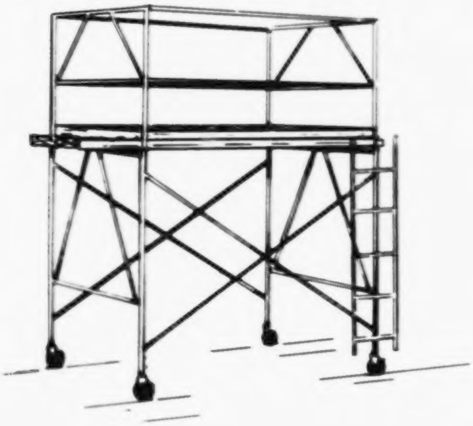
L. Attach ladder section (Figure 16)

FIGURE 16



M. Inspect completed scaffold (Figure 17)

FIGURE 17



LADDERS AND SCAFFPOLDS
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with ladders and scaffolds to their correct defintions. Write the correct numbers in the blanks.

_____a. Wheel used to support scaffold; mounted in a swivel frame and usually furnished with brakes
   1. Drive wheel
   2. Safety wheel
   3. Caster

_____b. Short member on which the scaffold planks or platform is laid and attached
   1. Bearer
   2. Putlog
   3. End frame

_____c. Any small member used primarily to support another member or structure
   1. End frame
   2. Bearer
   3. Mudpad

_____d. Federal legislation designed to ensure safe and sanitary working conditions for employees
   1. AGC
   2. HOSA
   3. OSHA

_____e. Type of scaffold normally hung from top of a structure for which it is not practical to build a scaffold
   1. Swinging scaffold
   2. Boatswain chair
   3. Basket

_____f. Scaffold that is constructed and set up on site where it is to be used
   1. Prefabricated scaffold
   2. Swinging scaffold
   3. Job-built scaffold

_____g. Guardrails attached on scaffolds about 42 inches high and midway between 42 inches and toeboard
   1. Bearers
   2. Safety rails
   3. Crossbraces

_____h. Heavy pieces of wood nailed together to form pads about 18 inches square; used on ground to support scaffolds
   1. Toeboards
   2. Mudpads
   3. Bearers

TEST

_____i. Rope used to guide or steady a load being hoisted
1. Tagline
2. Swinging line
3. Hoist line

_____j. Angle-shaped devices manufactured to fasten on forms in pairs to support a platform for workers and materials
1. Side bracket
2. Ladder jacks
3. Scaffold jacks

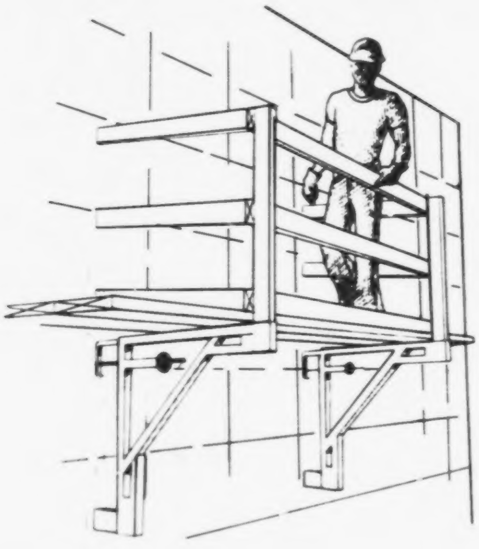
_____k. Four-inch guardrails attached 1/4 inch above scaffold platform to prevent tools and materials from falling from scaffold
1. Toeboards
2. Safety rails
3. Bearers

_____l. Safety device on the bottom of ladders; used to prevent ladder heel from sliding
1. Mudpad
2. Putlog
3. Safety shoe

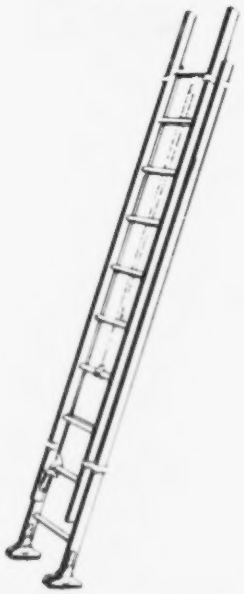
_____m. Board nailed to the bottom of the scaffold planks to hold them together and to keep them from sliding off the end frames
1. Toeboard
2. Putlog
3. Cleat

2. Identify the following types of ladders and scaffolds. Write the correct names in the blanks.

Extension ladder
Swinging scaffold
Single-pole scaffold
Scaffold jacks with platform
Single, straight ladder
Double-pole scaffold
Tubular, locking scaffold
Prefabricated scaffold
Stepladder

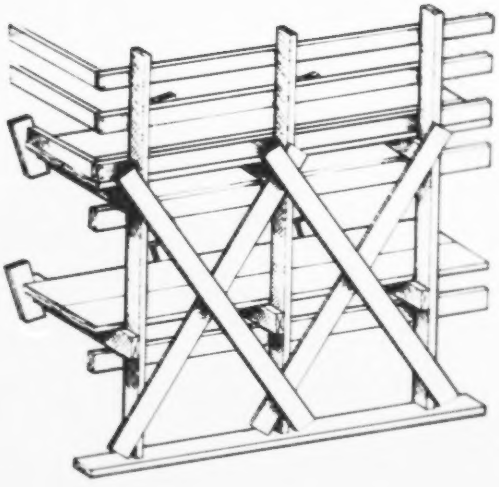


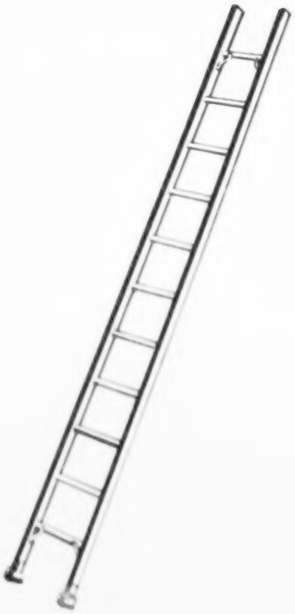
a. ______________________________



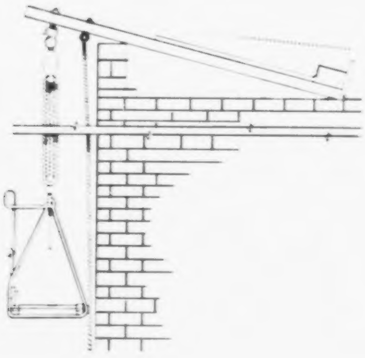
b. ______________________________

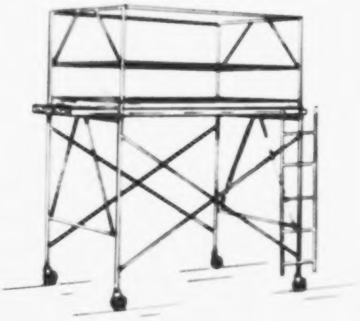
TEST





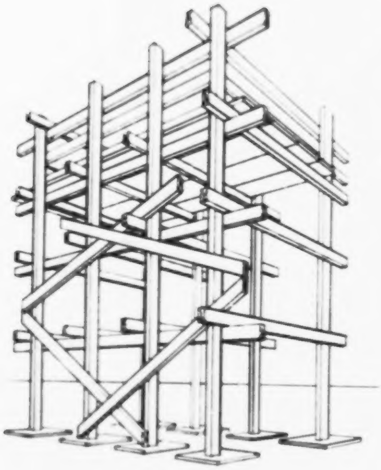
c. ______________________________ d. ______________________________

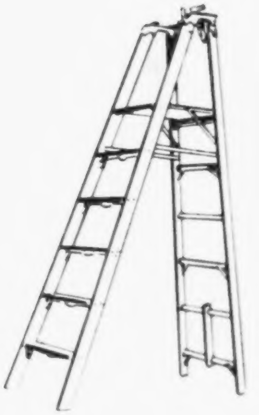




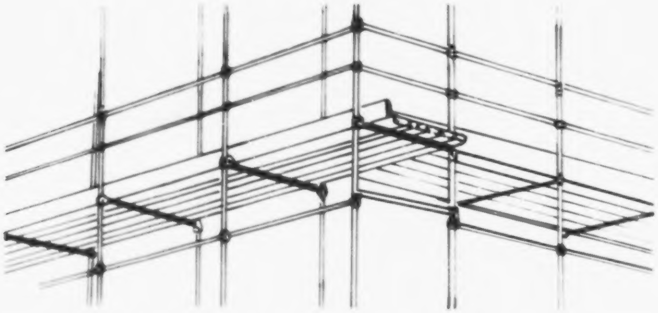
e. ______________________________ f. ______________________________

TEST





g. ______________________________ h. ______________________________

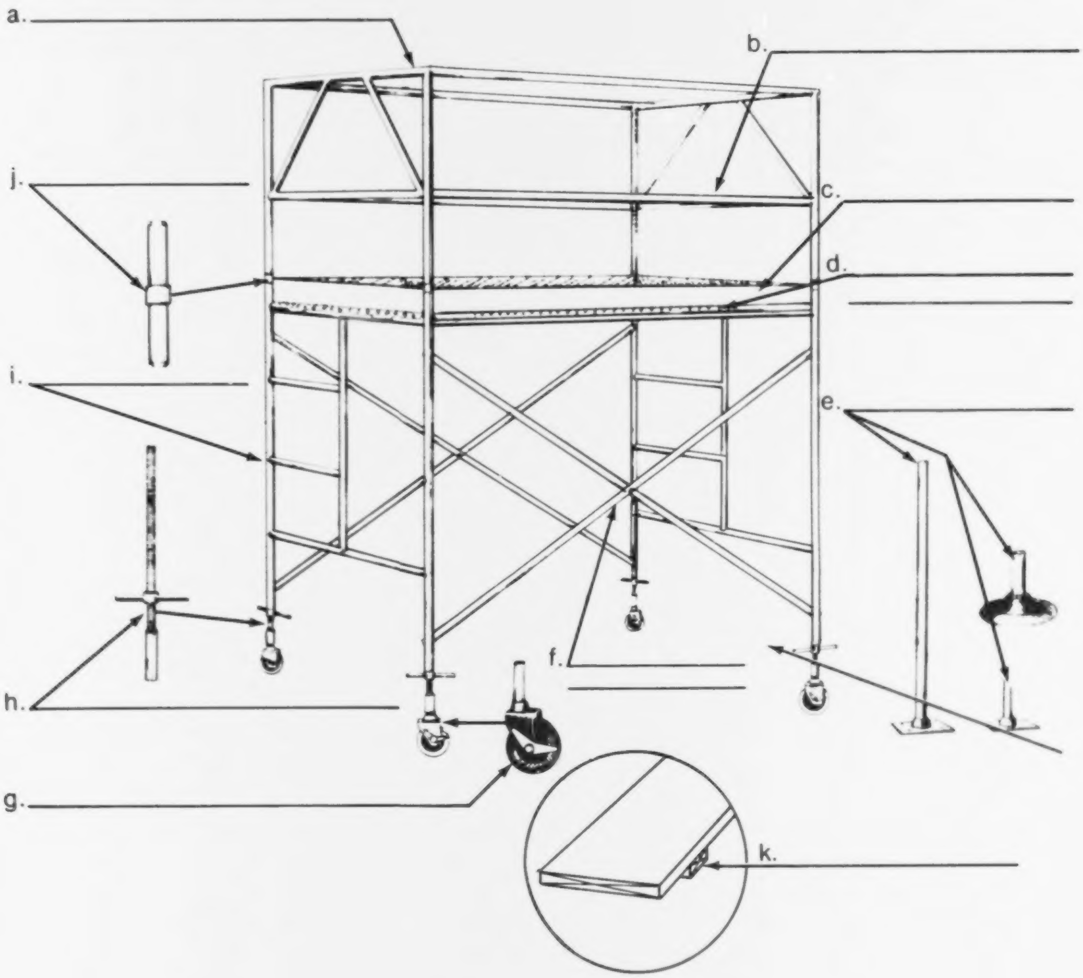


i. ______________________________

TEST

3. Identify the parts of the prefabricated rolling scaffold illustrated below. Write the correct names in the blanks.

Crossbrace
Screw jack
Top guardrail
Middle guardrail
Base plates
Cleat
Scaffold planks or platform
Toeboard
Caster
End frame
Coupling pin



TEST

4. State five safety precautions pertaining to ladders and five pertaining to scaffolds.

   a. Ladders

      1) ____
      ____

      2) ____
      ____

      3) ____
      ____

      4) ____
      ____

      5) ____
      ____

   b. Scaffolds

      1) ____
      ____

      2) ____
      ____

      3) ____
      ____

      4) ____
      ____

      5) ____
      ____

(NOTE: Test question 5 lists the job sheet. It is an important part of this test. If it has not been completed, check with your instructor.)

5. Demonstrate the ability to set up a section of scaffold.

LADDERS AND SCAFFOLDS
UNIT II

ANSWERS TO TEST

1. a. 3
   b. 2
   c. 2
   d. 3
   e. 1
   f. 3
   g. 2
   h. 2
   i. 1
   j. 3
   k. 1
   l. 3
   m. 3

2. a. Scaffold jacks with platform
   b. Extension ladder
   c. Single-pole scaffold
   d. Single, straight ladder
   e. Swinging scaffold
   f. Prefabricated scaffold
   g. Double-pole scaffold
   h. Stepladder
   i. Tubular, locking scaffold

3. a. Top guardrail
   b. Middle guardrail
   c. Toeboard
   d. Scaffold planks or platform
   e. Base plates
   f. Crossbrace
   g. Caster
   h. Screw jack
   i. End frame
   j. Coupling pin
   k. Cleat

4. a. **Ladders**

   (Answer should include any five of the following)

   1) Fully spread and lock any stepladder before using
   2) Do not use ladders that are not equipped with safety shoes
   3) Never overreach from a ladder
   4) Never work from the top step of any ladder
   5) Never use a metal ladder when there is any possibility of contact with electrical conductors
   6) Never use ladders in a horizontal position
   7) Do not climb on a ladder that is occupied by someone else
   8) Remove ladder when you are finished using it, and always remove and store ladder at end of workday
   9) Place ladders approximately one-quarter of their support length away from vertical plane of top support, and extend ladders a minimum of 3 feet above top support
   10) Secure ladders at both top and bottom to prevent displacement; brace long ladders at intermediate points to prevent spring

ANSWERS TO TEST

b. **Scaffolds**

(Answer should include any five of the following)

1) Always check for electrical wires; deenergize them before erecting metal scaffolding in the vicinity
2) Be sure that wheels are locked on rolling scaffolds before ascending
3) Do not work on scaffolds during storms, high winds, or when scaffolds are covered with ice or snow
4) Tie off scaffolds about every 25 feet when they are built several sections high
5) Do not overload scaffolds
6) Be sure that scaffolds are equipped with top rail (42 inches high), midrail, and toeboard
7) Be sure that scaffold boards have cleats
8) Use safety belts, harness, and nets as required

5. Performance skills evaluated to the satisfaction of the instructor

RIGGING AND MATERIAL HANDLING
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to rig and handle different types of loads safely. The student will show this knowledge by completing assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with rigging to their correct definitions.
2. Identify accessories used for load lifting.
3. Identify hitches used for attaching materials and equipment to the hoist.
4. Label devices and types of rigging used to handle panels.
5. Label elements of knots, bends, and hitches.
6. Match types of knots to their correct uses.
7. State safety tips related to rigging.
8. Match types of rope materials to their correct characteristics.
9. Explain general construction of rope.
10. State precautions to observe when caring for ropes.
11. State the importance of sling angles.
12. Distinguish among hand signals used in rigging operations.
13. Select from a list good rigging practices.
14. Distinguish among types of knots.
15. Identify unsafe rigging practices.
16. Demonstrate the ability to
    a. Tie knots.
    b. Install wire rope clips.
    c. Rig and handle different types of loads, using proper hand signals.

RIGGING AND MATERIAL HANDLING
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Information sheet

  D. Assignment sheets

    1. Assignment Sheet #1 — Distinguish Among Types of Knots

    2. Assignment Sheet #2 — Distinguish Among Hand Signals Used in Rigging Operations

    3. Assignment Sheet #3 — Identify Unsafe Rigging Practices

  E. Answers to assignment sheets

  F. Job sheets

    1. Job Sheet #1 — Tie Knots

    2. Job Sheet #2 — Install Wire Rope Clips

    3. Job Sheet #3 — Rig and Handle Different Types of Loads, Using Proper Hand Signals

  G. Test

  H. Answers to test

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Obtain materials needed to supplement presentation.

    1. Order competency profiles.

    (NOTE: Competency profiles for this series are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, DC 20006, phone 202-393-2040.)

    2. Obtain ropes for student practice and rigging equipment for demonstrations.

SUGGESTED ACTIVITIES

(NOTE: Some instructors prefer to use ropes of two different colors to demonstrate knots that join two ropes.)

3. Obtain posters of rigging knots.

4. Film—*Rigging Wire-Rope Slings*, 18 minutes, 1976, catalog number PC217, rental only. Available from Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077-4321. This film explains conditions required for safe and proper rigging procedures.

C. Introduce unit.

- Visit a construction site or show the class a large picture of a construction site and point out rigging operations in progress and large equipment or material loads that probably required rigging for placement; you may wish to have students see how many rigging requirements they can identify.
- Assemble some rope and materials, such as three six-foot posts, and ask for students to tie the material so that it can be hoisted.

  (NOTE: Many students will be unable to secure the load, and this will give you the opportunity to motivate them to master skills taught in the unit. However, some of your students may have acquired some rigging skills or at least be familiar with some rigging knots. These students will be able to help you teach knot tying to other students.)

D. Provide students with objective page.

E. Discuss unit and specific objectives, relating the objectives to your introduction to the unit.

F. Provide students with information sheet.

G. Discuss information sheet.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with rigging.
   - Display examples of equipment and materials when possible.
   - Set up a hoist with block and tackle so that you can relate terms such as *tagline* and *heave* more effectively.
   - Have examples of rope and wire rope cut in cross-section to show *lay*, *core*, and other characteristics.
   - Demonstrate ways of determining the approximate center of gravity of a load.
2. Use Information Sheet, Section II, and actual examples of accessories to discuss accessories used for load lifting; demonstrate the use of each.
3. Use Information Sheet, Section III, and actual hitches to discuss hitches used to attach materials and equipment to the hoist; demonstrate the use of each type of hitch.

SUGGESTED ACTIVITIES

4. Use Information Sheet, Section IV, to discuss devices and types of rigging used to handle panels.

5. Use Information Sheet, Section V, to discuss elements of knots, bends, and hitches.

6. Use Information Sheet, Section VI, to discuss uses of knots.

   - Demonstrate tying each type of knot and associate it with an on-the-job application.

   - Provide the students with Job Sheet #1 and allow them to practice tying knots; use skilled students to teach other class members.

   - Provide students with Assignment Sheet #1 to allow further practice in identifying knots.

   - Emphasize the loss of strength in rope at tie points.

7. Use Information Sheet, Section VII, to discuss safety tips related to rigging.

   - Invite construction workers who have been injured in rigging accidents to discuss their experiences.

   - Demonstrate the tips so that students will understand the use of safety snaps, outriggers, heaving, etc.

8. Use Information Sheet, Section VIII, to discuss characteristics of materials used in rope construction.

   - Use samples of each type of rope to demonstrate relative strength and stretch characteristics. Try lifting the same size load with each type; some types will be able to lift it and some will not.

   - Show students samples of worn, weathered, decayed, mildewed, and other defective ropes.

   - Discuss size availability, costs, workability, and other factors to consider in choosing rope.

9. Use Information Sheet, Section IX, and an unbraided rope to discuss rope construction.

10. Use Information Sheet, Section X, to discuss precautions to observe when caring for ropes; demonstrate the correct procedures for coiling and uncoiling, washing, storing, and lubricating rope.

    - Have students perform Job Sheet #2, "Install Wire Rope Clips."

SUGGESTED ACTIVITIES

11. Use Information Sheet, Section XI, to discuss the importance of sling angles.

    - Use a sling to demonstrate what is meant by sling angles; show two-, three-, and four-legged slings; point out that various sources refer to sling angle as that between rope and horizontal, while others use between rope and vertical.

    - Use the concept of critical angle to show how the strength of a sling may be increased by increasing the angle or by increasing the number of legs.

12. Use Information Sheet, Section XII, to discuss hand signals used in rigging operations.

    - Demonstrate the hand signals. Use model cranes to illustrate the operator's responses.

    - Divide the class into two-student teams to study hand signals. Have the teams compete against each other with one team member being the signaller and the other being the operator.

    - Provide students with Assignment sheet #2 to allow practice with hand signals.

13. Use Information Sheet, Section XIII, to discuss good rigging practices.

    - Demonstrate procedures listed.

    - Provide students with Job Sheet #3 and allow them to practice procedures. Expand job sheet to include rigging practices listed, having students rig load and signal crane operator.

    - Provide students with Assignment Sheet #3 and encourage open discussion of rigging practices.

H. Review unit.

I. Give test.

J. Critique and discuss test with students.

K. Reteach and retest as required.

L. Complete appropriate sections of competency profiles.

III. Unit reference

Hendrix, Laborn J. "Bud." *Commercial Carpentry.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1986.

RIGGING AND MATERIAL HANDLING
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. **Rigging** — Setting up block and tackle to a winch, stacking and hoisting material and equipment, or replacing cables on equipment

B. **Hitch** — To attach a rope to a post, pole, ring, hook, or other object

C. **Tagline** — Rope used to guide or steady load while being lifted

D. **Heave** — To pull from below the load, but not directly under it

E. **Tackle** — Assembly of blocks and lines used to gain a mechanical advantage in lifting

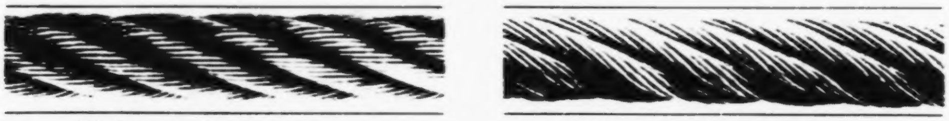
F. **Sheave** — Grooved wheel or pulley

G. **Preforming** — Preliminary shaping of wires so that they will lie in place

H. **Lay** — Direction, length, or angle of twist of strands in a rope or cable (Figure 1)

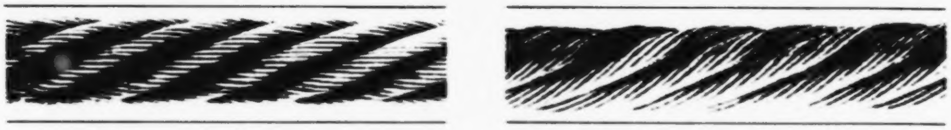
EXAMPLES:

FIGURE 1



Right, regular-lay rope

Right, Lang-lay wire rope



Left, regular-lay rope

Left, Lang-lay wire rope

I. **Snatch block** — Pulley in a case that can be easily fastened to lines or objects by means of a hook, ring, or shackle

J. **Core** — Material used in the center of wire rope

K. **Spreaders** — Devices used to prevent crushing of load and to lift extra long and heavy loads

L. **psi** — Pounds per square inch

M. **Center of gravity** — Point at which entire weight may be considered as concentrated

INFORMATION SHEET

N. **Eye** — Metal loop that engages a hook

O. **Thimble** — Grooved metal ring inserted in loop of rope to prevent wear

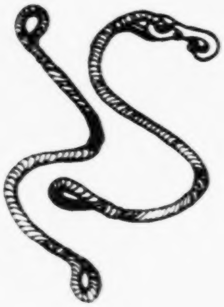
P. **Dog** — Slang meaning to slow down the work pace deliberately

Q. **Splice** — To join two sections of rope or cable together to form a continuous length

II. Accessories used for load lifting (Figures 2-8)

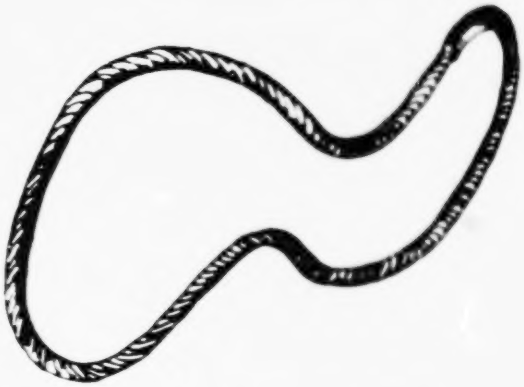
A. Choker (single sling)

FIGURE 2



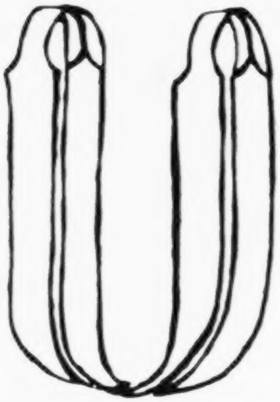
B. Grommet sling

FIGURE 3



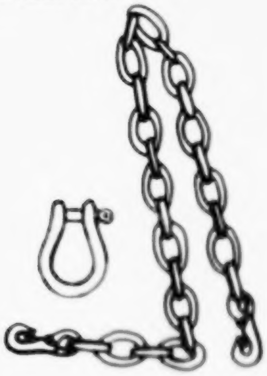
C. Web sling

FIGURE 4



D. Chain and shackle

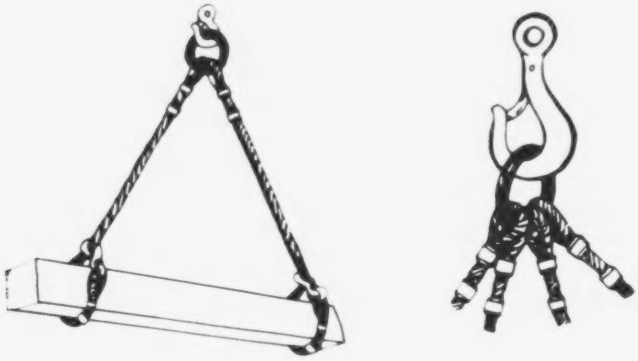
FIGURE 5



INFORMATION SHEET

E. Bridle

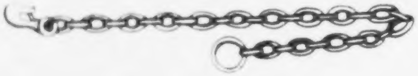
FIGURE 6



F. Bull chain

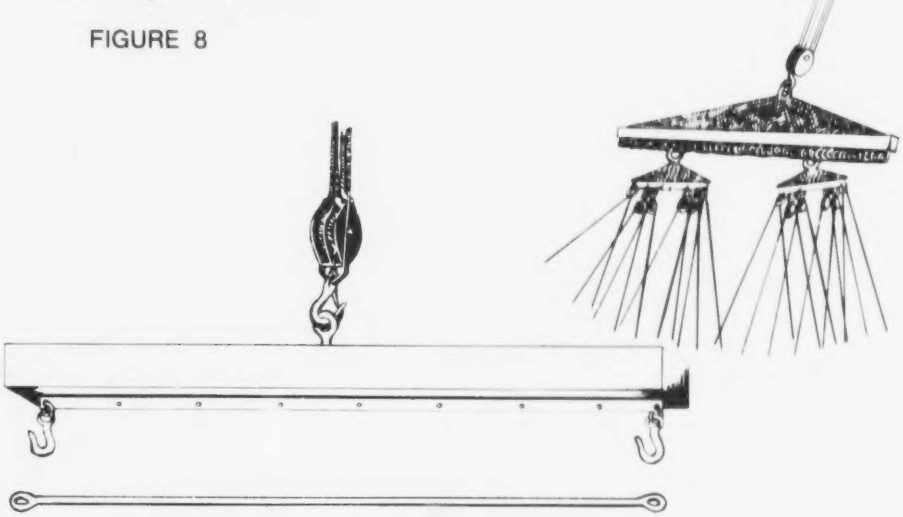
(NOTE: Chains are used mainly for towing and for securing equipment.)

FIGURE 7



G. Spreader bars

FIGURE 8



INFORMATION SHEET

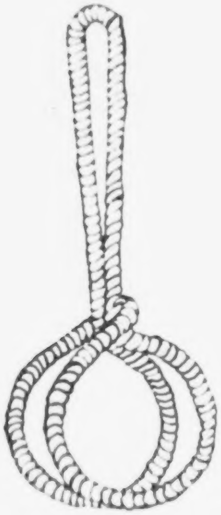
III. Hitches used to attach materials and equipment to the hoist (Figures 9-13)

CAUTION

The placement of hitches on the load is very critical. Caution must be taken to be sure hitches are made secure and safe.)

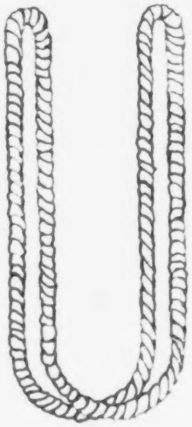
A. Choker hitch sling

FIGURE 9



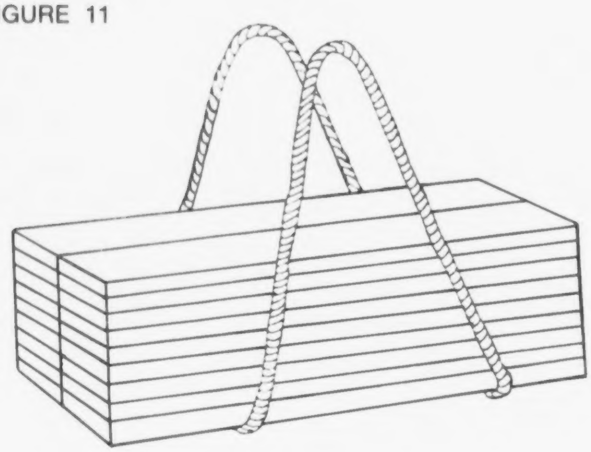
B. Basket hitch sling

FIGURE 10



C. Inverted basket hitch sling

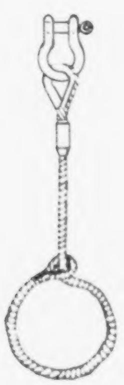
FIGURE 11



INFORMATION SHEET

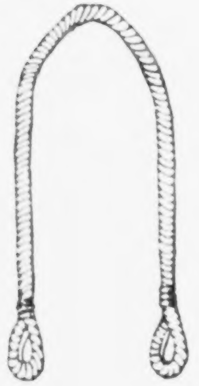
D. Choker hitch choker

FIGURE 12



E. Basket hitch choker

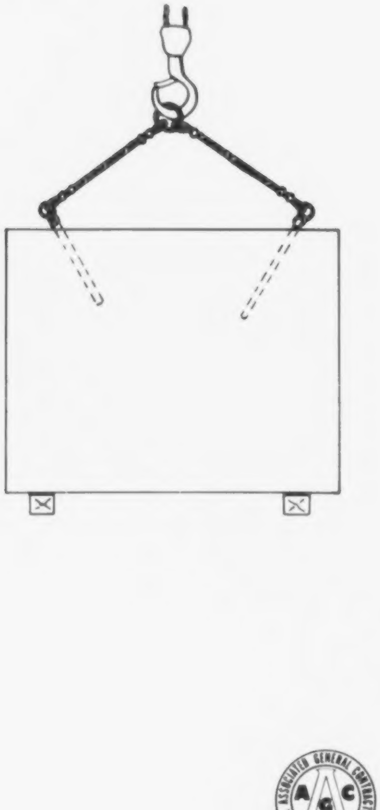
FIGURE 13



IV. Devices and types of rigging used to handle panels (Figure 14-21)

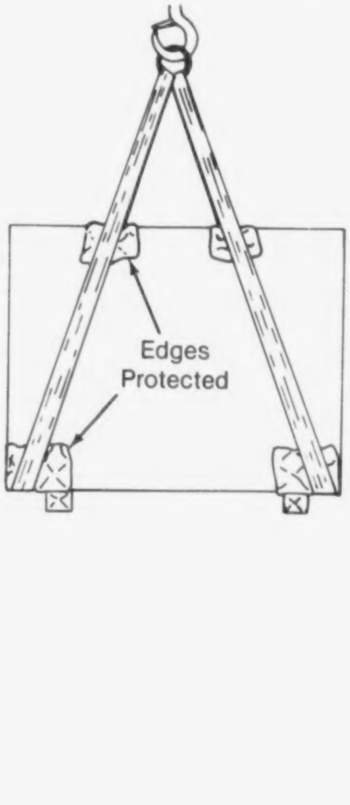
A. Lewis pins and bridle

FIGURE 14



B. Straps or web slings

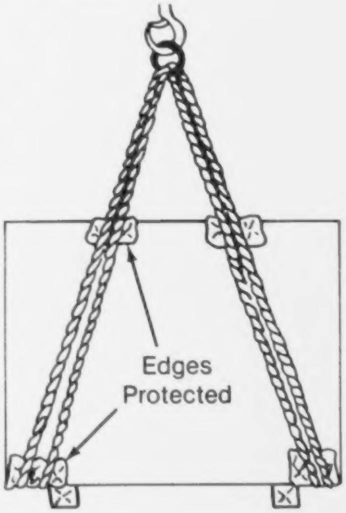
FIGURE 15



INFORMATION SHEET

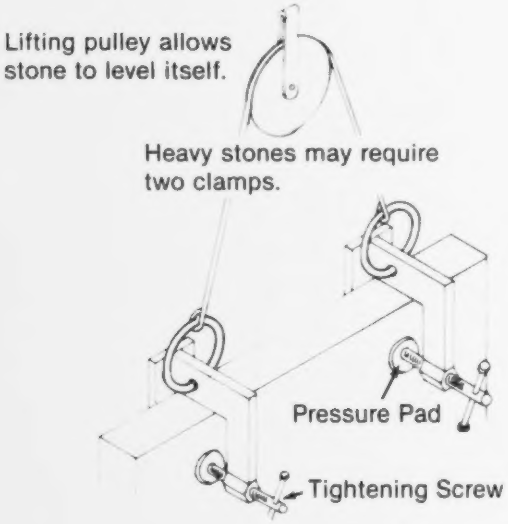
C. Chokers or slings

FIGURE 16


Edges
Protected

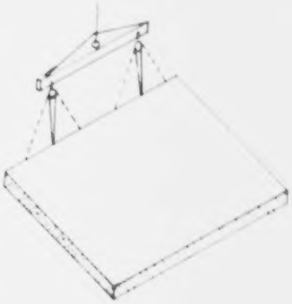
D. Stone clamps

FIGURE 17


Lifting pulley allows stone to level itself.
Heavy stones may require two clamps.
Pressure Pad
Tightening Screw

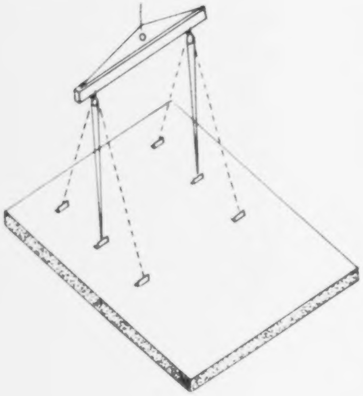
E. Basic edge lift

FIGURE 18



F. Basic two-point lift

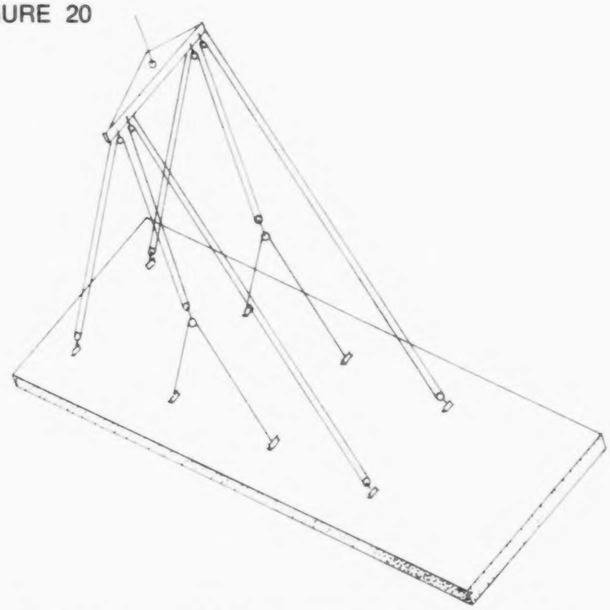
FIGURE 19



INFORMATION SHEET

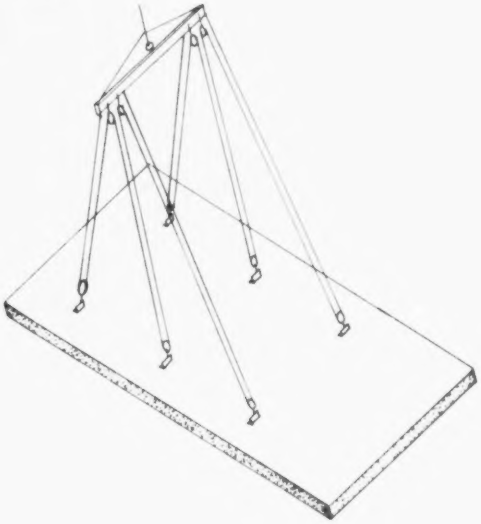
G. High rigging with approximately equal loads

FIGURE 20



H. High rigging modified for panels of various widths

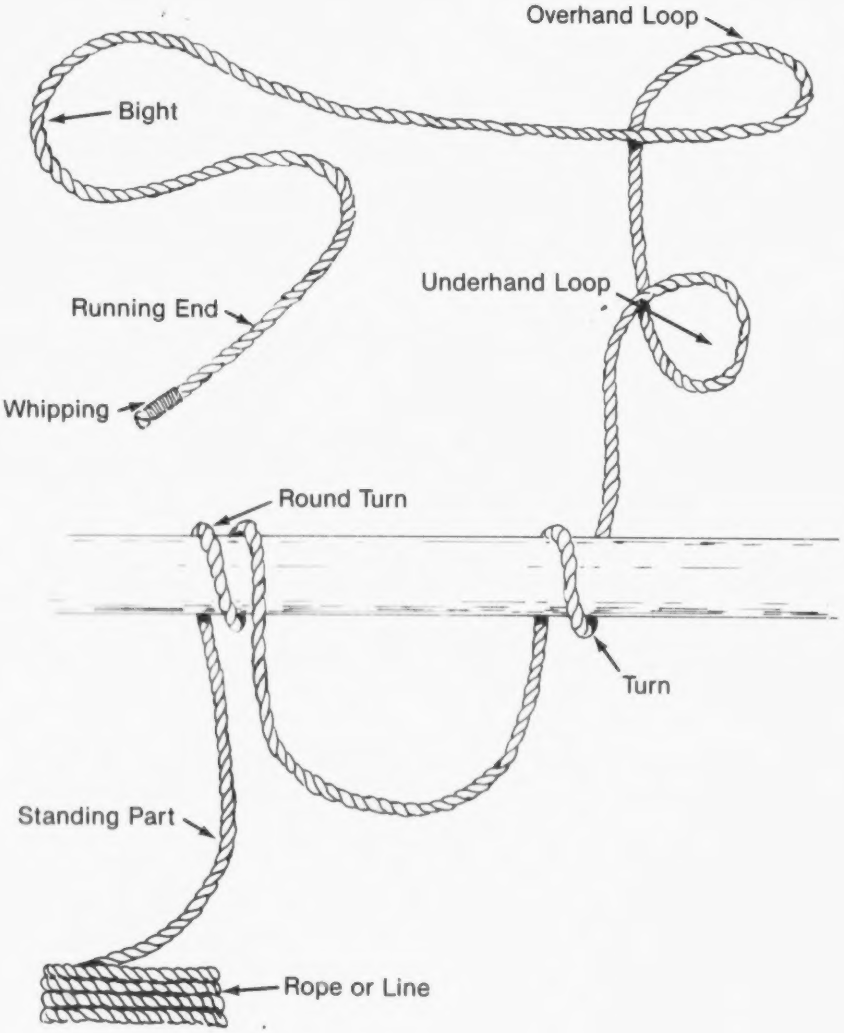
FIGURE 21



INFORMATION SHEET

V. Elements of knots, bends, and hitches (Figure 22)

FIGURE 22


Overhand Loop
Bight
Underhand Loop
Running End
Whipping
Round Turn
Turn
Standing Part
Rope or Line

INFORMATION SHEET

VI. Correct uses of types of knots (Figures 23-33)

(NOTE: Efficiency of manila rope decreases considerably when using knots and splices.)

EXAMPLE: Straight rope = 100% strength

Eye splice = 85% strength

Clove hitch = 75% strength

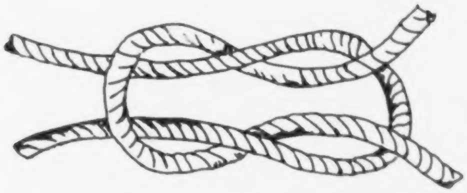
Bowline = 53% strength

Square knot = 43% strength

Sheepshank = 35%

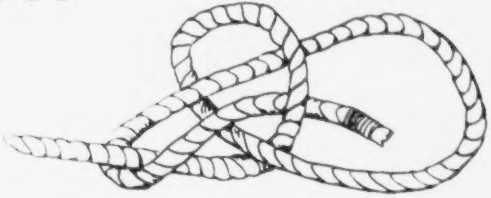
A. Square knot — Ties two lines of equal size together so that they will not slip

FIGURE 23



B. Bowline — Forms a single loop that will not tighten or slip under strain

FIGURE 24

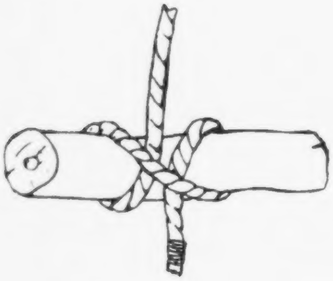


INFORMATION SHEET

C. Clove hitch — Fastens a line to timber or pipe

(NOTE: This is probably one of the most widely used knots.)

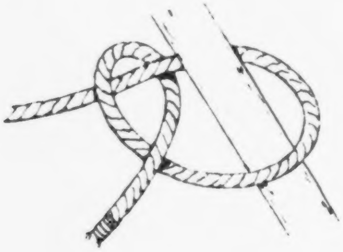
FIGURE 25



D. Half hitch — Ties line to timber or a larger line

(NOTE: This a quick and easy knot to use when tying down a tarp or plastic covering.)

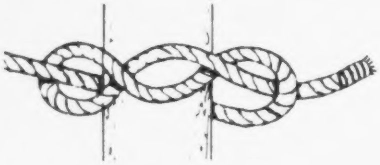
FIGURE 26



E. Timber hitch — Holds timber securely when moving heavy timber or poles

(NOTE: Because of the pressure of one coil over the other; the more tension that is applied, the tighter the hitch becomes.)

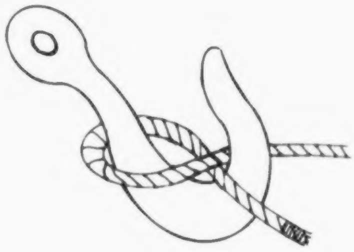
FIGURE 27



INFORMATION SHEET

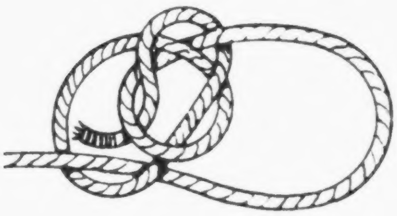
F. Blackwall hitch — Fastens a line to a hook; generally used temporarily

FIGURE 28



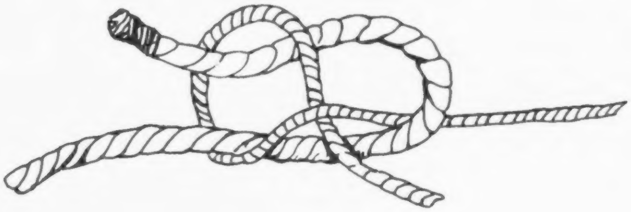
G. Running bowline — Forms a strong running loop that is convenient for running an eye; can also provide a choker-type sling at the end of a line

FIGURE 29



H. Sheet bend — Ties two lines of unequal size together; also used to tie a line to an eye

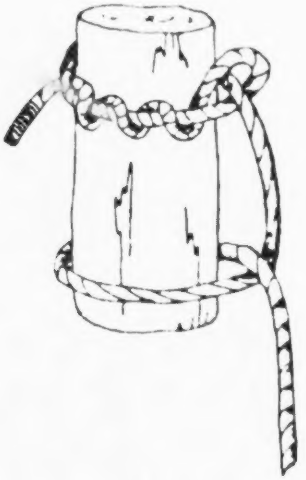
FIGURE 30



INFORMATION SHEET

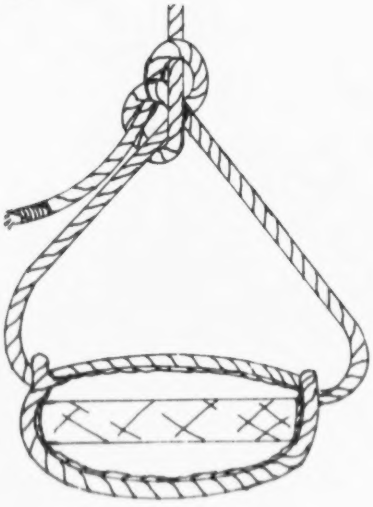
I. Timber hitch with half hitch — Holds heavy timbers or poles for lifting or dragging

FIGURE 31



J. Scaffold hitch — Supports ends of scaffold plank and prevents it from tilting

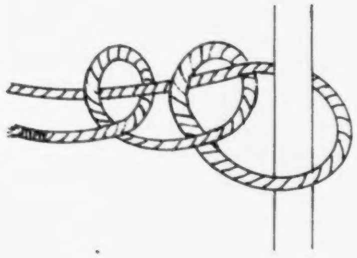
FIGURE 32



INFORMATION SHEET

K. Two half hitches — Secure running end of line to standing part

FIGURE 33



VII. Safety tips related to rigging

A. Use personal protective devices such as goggles, gloves, safety shoes, and hard hats

B. Use tagline to guide or steady load

C. Do not walk under load

D. Be sure load is balanced properly

E. Do not overload equipment

F. Use corner saddles, padding, or wood blocking to protect slings from sharp bends and sharp edges

G. Stand clear when slings are heaved from under loads

H. Avoid heavy or continous overloading

I. Be sure outriggers or stabilizers are in use and are on solid footing

J. Lubricate slings to prevent rust

K. Be sure all hooks have safety snaps

L. Be extra cautious around power lines

CAUTION

There must be a minimum of ten feet between equipment and power lines. Check local requirements.

INFORMATION SHEET

VIII. Characteristics and types of rope materials

A. **Manila** — Strong and durable; used where dependability, ability to stand up under severe use, and resistance to weathering are required

B. **Sisal** — Low durability and strength; low cost

(NOTE: Manila and sisal are natural materials. The remaining materials listed are manufactured.)

C. **Nylon** — Very strong, high abrasion resistance, good resistance to weathering, and high degree of stretch

(NOTE: Nylon rope is approximately twice as strong as manila rope of the same diameter.)

D. **Polyester (terylene or dacron)** — Less strength than nylon; little stretch

E. **Polypropylene** — Slightly less strength than nylon; little stretch; very light, actually floats on water; resistant to rot

F. **Polyethylene** — Less strength than nylon; high stretch; excellent resistance to mildew, decay, acids, and alkalies

IX. General construction of rope

A. Rope is normally made of three strands, each of which is made of several threads

B. The rope itself is twisted in a right-hand direction while each strand is twisted in a left-hand direction and the individual threads are twisted in a right-hand direction

C. Reversal of twist in strands gives the rope a balance or set, which eliminates the tendency to unwind

X. Precautions to observe when caring for ropes

A. When taking rope from a coil, always remove it from the center in a counterclockwise direction

B. When rope is not in use, re-coil it in a clockwise direction

C. When rope is attached to a hook, ring, or pulley block, place a thimble in the loop or eye to reduce wear and to decrease stress

D. Protect rope from moisture and weather as much as possible

E. Do not disturb a frozen rope until it is completely thawed

INFORMATION SHEET

F. Keep rope away from acids, other chemicals, and heat

G. Do not drag rope over ground or sharp edges

H. If possible, do not make abrupt bends in rope

I. Wash and dry dirty rope before storing it

J. Store rope so that air may circulate around it

(NOTE: Hang rope in loose coils or place on wood grating above the floor.)

K. If manila rope becomes stiff and hard because of being wet, treat it with a thin lubricating oil or warm petrolatum (a jellylike petroleum-based dressing.)

(NOTE: This can be accomplished by applying the lubricant with a paint brush.)

XI. Importance of sling angles

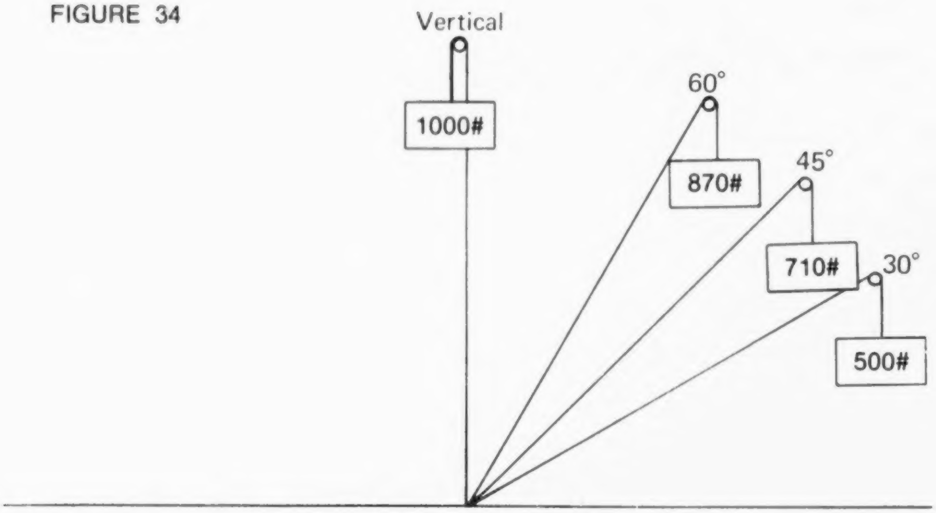
A. Decreasing angle of sling leg increases the stress on the sling

B. As the angle is reduced, lifting capacity decreases very rapidly

(NOTE: When the single leg of the sling is at a 60-degree angle, the lifting capacity is only 87 percent of a vertical leg. At a 45-degree angle, the lifting capacity is 71 percent of that of vertical leg, while at a 30-degree angle, the lifting capacity is 50 percent of that of a vertical leg. See Figure 34.)

EXAMPLE:

FIGURE 34



INFORMATION SHEET

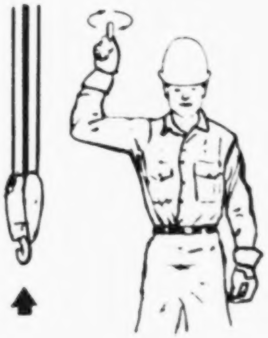
XII. Hand signals used in rigging operations

A. Hoist operations

1. Hoist the load (Figure 35)

(NOTE: Raise forearm vertical, forefinger pointing up; move hand in small, horizontal circle.)

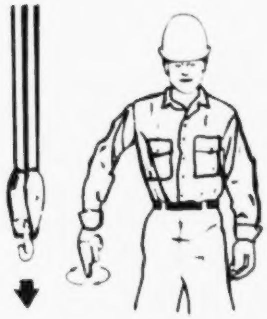
FIGURE 35



2. Lower the load (Figure 36)

(NOTE: Extend arm downward, forefinger pointing down; move hand in small, horizontal circle.)

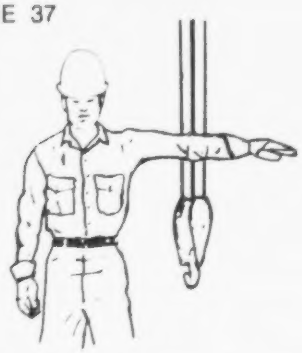
FIGURE 36



3. Stop (Figure 37)

(NOTE: Extend arm, palm down, and hold rigid.)

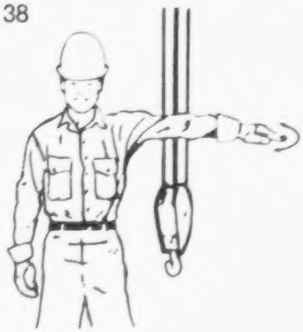
FIGURE 37



4. Emergency stop (Figure 38)

(NOTE: Extend arm, palm down; move hand rapidly right and left.)

FIGURE 38

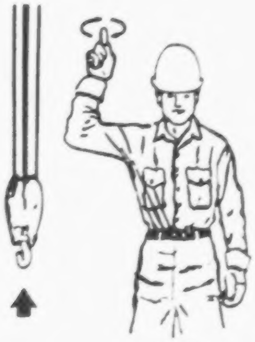


B. Boom operation

1. Hoist (Figure 39)

(NOTE: Raise forearm vertical, forefinger pointing up; move hand in small, horizontal circle.)

FIGURE 39

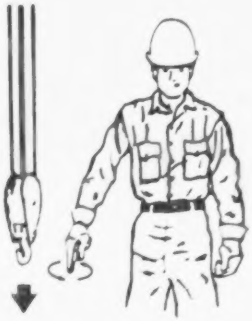


INFORMATION SHEET

2. Lower (Figure 40)

(NOTE: Extend arm downward, forefinger pointing down; move hand in small horizontal circles.)

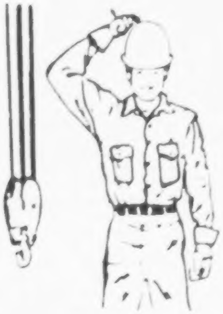
FIGURE 40



3. Use main hoist (Figure 41)

(NOTE: Tap first on head, then use regular signals.)

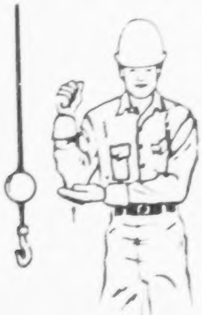
FIGURE 41



4. Use whipline (Figure 42)

(NOTE: Tap elbow with one hand, then use regular signals.)

FIGURE 42

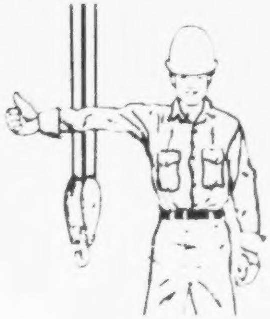


INFORMATION SHEET

5. Raise boom (Figure 43)

(NOTE: Extend arm with fingers closed; point thumb up.)

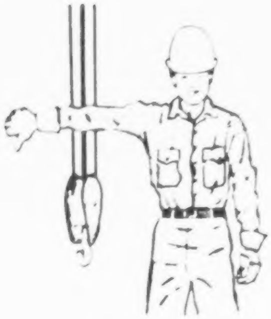
FIGURE 43



6. Lower boom (Figure 44)

(NOTE: Extend arm with fingers closed; point thumb down.)

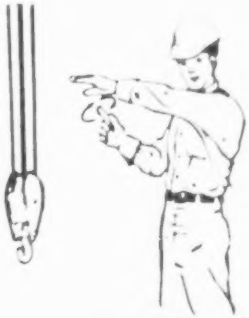
FIGURE 44



7. Move slowly (Figure 45)

(NOTE: Use one hand to give any signal and place other hand motionless in front of hand giving the motion signal. Hoist slowly is shown as an example.)

FIGURE 45

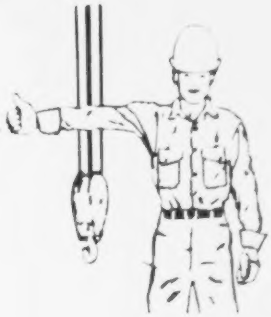


INFORMATION SHEET

8. Raise the boom and lower the load (Figure 46)

(NOTE: Extend arm with thumb pointing up; flex fingers in and out as long as load movement is desired.)

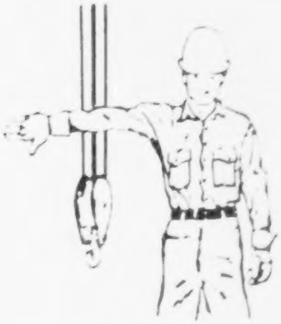
FIGURE 46



9. Lower the boom and raise the load (Figure 47)

(NOTE: Extend arm with thumb pointing down; flex fingers in and out as long as load movement is desired.)

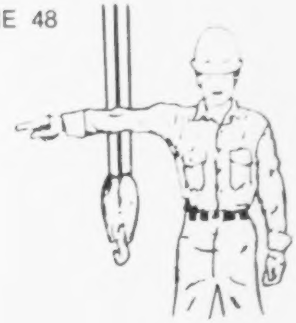
FIGURE 47



10. Swing (Figure 48)

(NOTE: Extend one arm and point with finger in direction of swing of boom.)

FIGURE 48

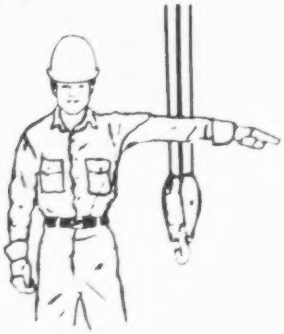


INFORMATION SHEET

11. Stop (Figure 49)

(NOTE: Extend arm with palm down; hold rigid.)

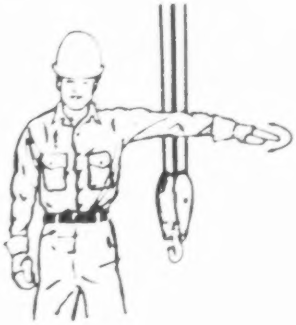
FIGURE 49



12. Emergency stop (Figure 50)

(NOTE: Extend arm with palm down; move hand rapidly right and left.)

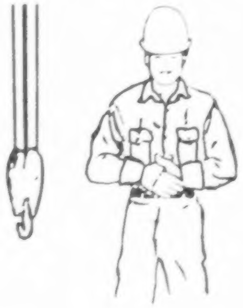
FIGURE 50



13. Dog everything (Figure 51)

(NOTE: Clasp hands in front of body.)

FIGURE 51

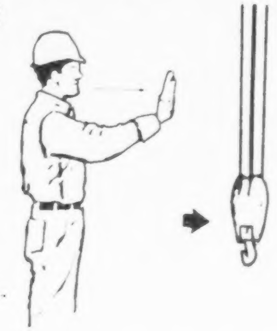


INFORMATION SHEET

14. Travel (Figure 52)

(NOTE: Extend arm forward with hand open and slightly raised; make pushing motion in direction of travel.)

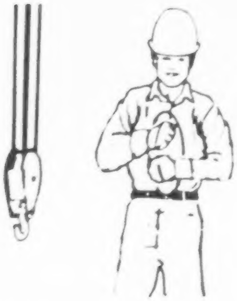
FIGURE 52



15. Travel: both tracks (Figure 53)

(NOTE: Use both fists in front of body, making a circular motion about each other indicating direction of travel [forward or backward, crawler cranes only].)

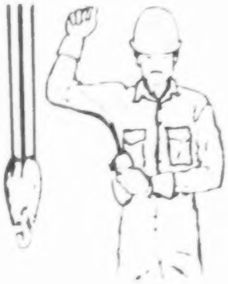
FIGURE 53



16. Travel: one track (Figure 54)

(NOTE: Lock the track on side indicated by raised fist; travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body [crawler cranes only].)

FIGURE 54

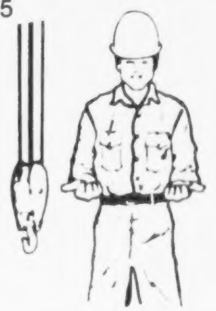


INFORMATION SHEET

17. Extend boom (Figure 55)

(NOTE: Raise both fists in front of body with thumbs pointing outward.)

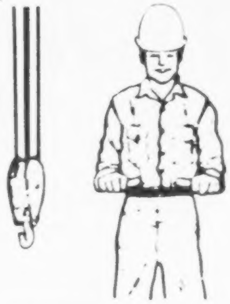
FIGURE 55



18. Retract boom (Figure 56)

(NOTE: Raise both fists in front of body with thumbs pointing toward each other.)

FIGURE 56

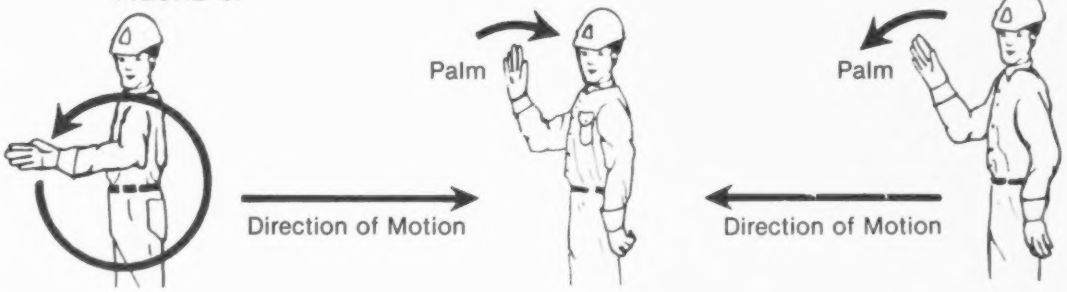


C. Vehicle maneuvering

1. Move forward or backward (Figure 57)

(NOTE: Move one arm in circular motion at elbow and then hold at side; extend other arm with hand flat and bend at elbow in direction of desired movement.)

FIGURE 57

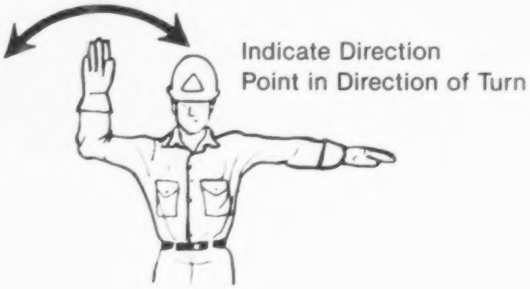


INFORMATION SHEET

2. Turn while moving (Figure 58)

(NOTE: Extend one arm, palm down, in direction of turn and hold rigid; raise other arm at elbow and wave hand back and forth.)

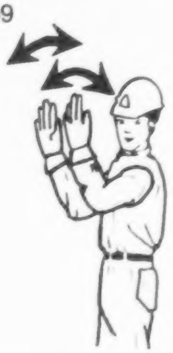
FIGURE 58


Indicate Direction
Point in Direction of Turn

3. Straighten out (Figure 59)

(NOTE: Turn side toward operator and extend arms in front, bent up at elbows; move hands back and forth.)

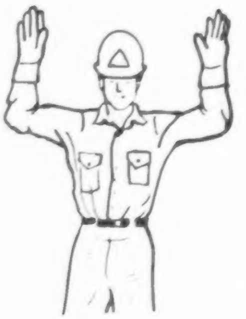
FIGURE 59



4. Stop (Figure 60)

(NOTE: Hold both arms out to side bent up at elbows, with palms toward operator and held rigid.)

FIGURE 60



INFORMATION SHEET

XIII. Good rigging practices

A. Turn hooks out

B. Use shackles on chokers where there may be cutting action

C. Pad all sharp corners and edges

D. Always make vertical lifts on eye bolts

(NOTE: Lifting at an angle reduces safe load as much as ninety percent.)

E. Use thimbles in eye splices

F. Use a shackle whenever two or more ropes are to be used over a hook

G. Use tagline to control loads

H. Secure all unused sling lines

I. Never wrap a rope around a hook

J. Do not permit rope to bend near a splice or attached fitting

K. Block all loads properly before unhooking

L. Never allow a shackle to be pulled at an angle

(NOTE: Use washers for packing if necessary.)

M. Do not use screw pin shackle if the pin can roll under load and unscrew

N. Center crane over load before lifting

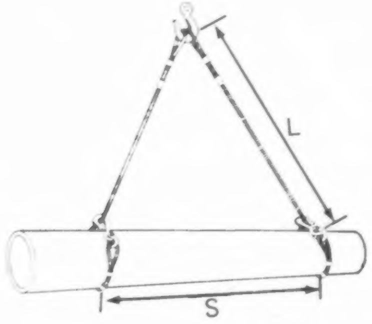
O. Give all hand signals clearly and correctly

P. Keep machines at least ten feet (10′) from all electrical equipment

Q. For proper sling angle, be sure length of slings is always greater than the span between the two connections (Figure 61)

EXAMPLE: L (length of sling) is greater than S (span)

FIGURE 61



FOC-123-C

RIGGING AND MATERIAL HANDLING
UNIT III

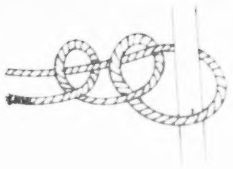
ASSIGNMENT SHEET #1 — DISTINGUISH AMONG TYPES OF KNOTS

NAME ______________________________ SCORE ______________

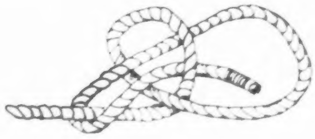
The movement and hoisting of heavy equipment and materials in the construction trades require that workers be familiar with rigging procedures, including how to tie a good knot. A good knot should be easy to tie, should hold without slipping, and should be easy to untie.

Distinguish among types of knots by writing an "X" in the blanks under the correct illustrations.

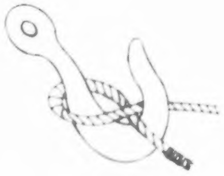
A. Bowline



1. ______________

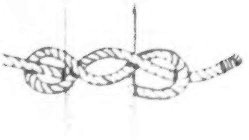


2. ______________

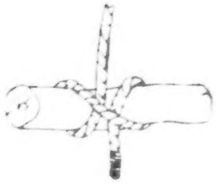


3. ______________

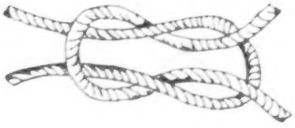
B. Square knot



1. ______________



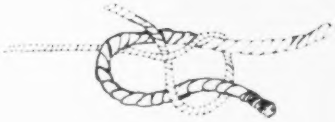
2. ______________

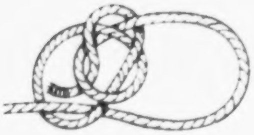


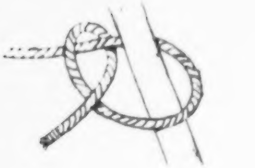
3. ______________

ASSIGNMENT SHEET #1

C. Sheet bend

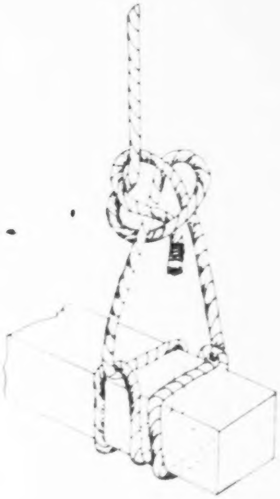


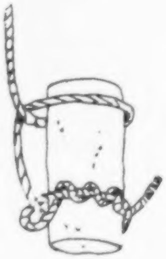


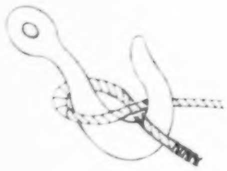


1. ______________________ 2. ______________________ 3. ______________________

D. Timber hitch with half hitch







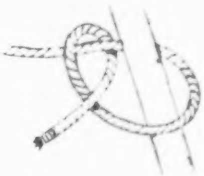
1. ______________________ 2. ______________________ 3. ______________________

Write an "X" in the correct blanks.

E. _____1. Timber hitch

_____2. Blackwall hitch

_____3. Half hitch

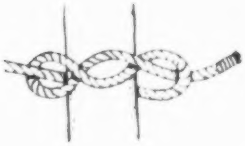


ASSIGNMENT SHEET #1

F. ______1. Clove hitch

______2. Timber hitch

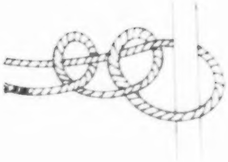
______3. Square knot



G. ______1. Two half hitches

______2. Sheet bend

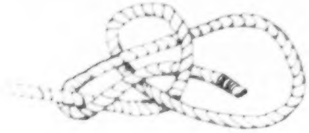
______3. Scaffold hitch



H. ______1. Square knot

______2. Bowline

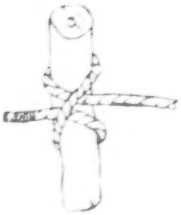
______3. Clove hitch



I. ______1. Timber hitch with half hitch

______2. Clove hitch

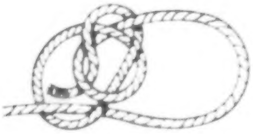
______3. Blackwall hitch



J. ______1. Bowline

______2. Half hitch

______3. Running bowline



RIGGING AND MATERIAL HANDLING
UNIT III

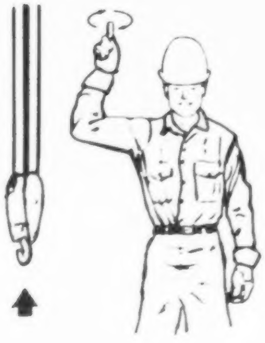
ASSIGNMENT SHEET #2 — DISTINGUISH AMONG HAND SIGNALS USED IN RIGGING OPERATIONS

NAME ______________________________ SCORE ______________

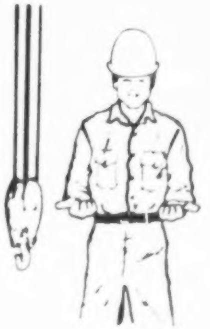
In heavy equipment operations, knowing how to use hand signals is very important. By knowing them, you will be able to direct operations efficiently; and you may be able to help another worker get out of a bad situation and possibly avoid a serious accident.

Distinguish among hand signals by writing an "X" under the correct illustrations.

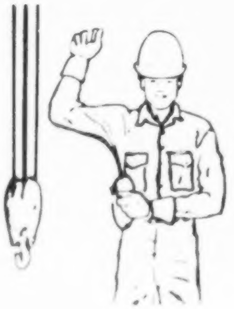
A. Hoist the load



1. ______________

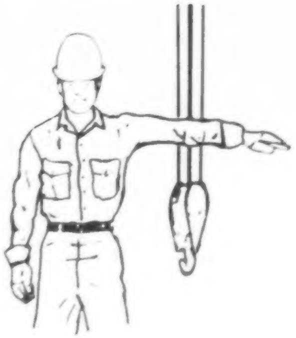


2. ______________

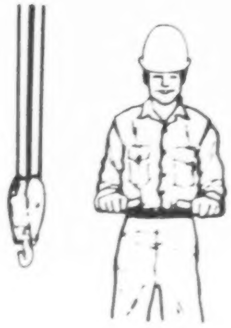


3. ______________

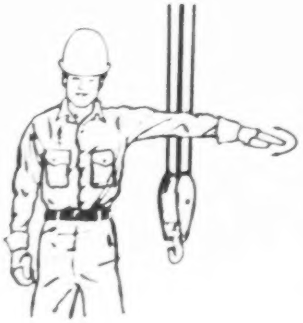
B. Emergency stop



1. ______________



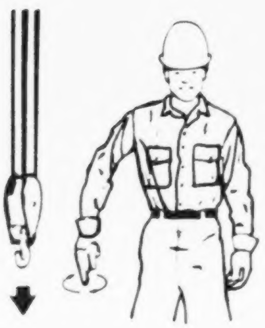
2. ______________

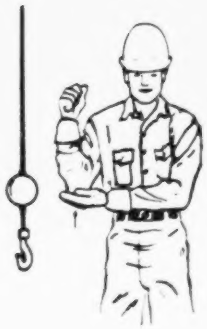


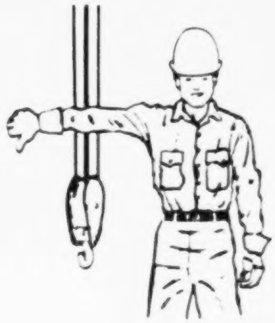
3. ______________

ASSIGNMENT SHEET #2

C. Lower the boom

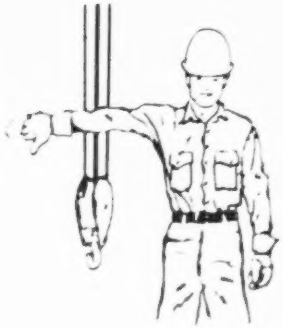


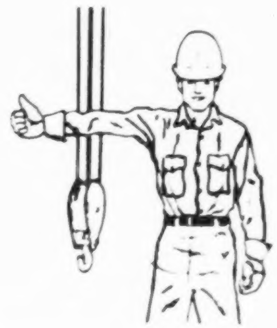


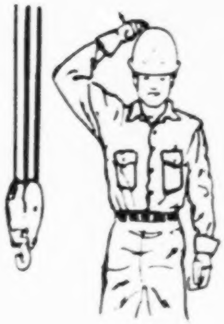


1. ______________________ 2. ______________________ 3. ______________________

D. Lower the boom and raise the load



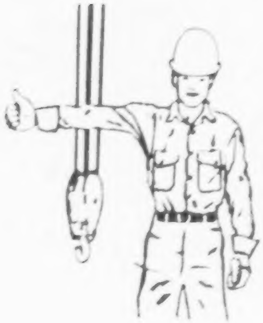


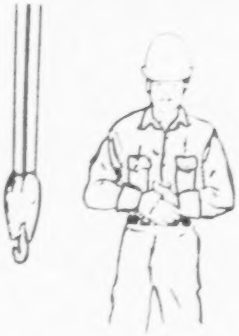


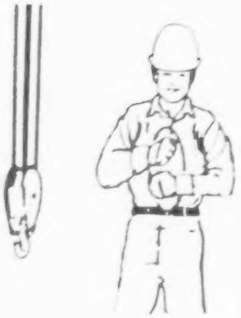
1. ______________________ 2. ______________________ 3. ______________________

ASSIGNMENT SHEET #2

E. Dog everything

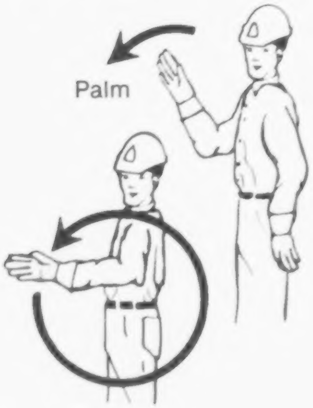


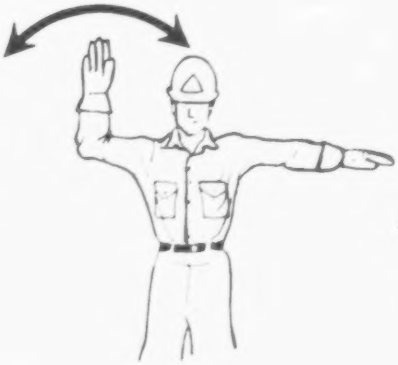


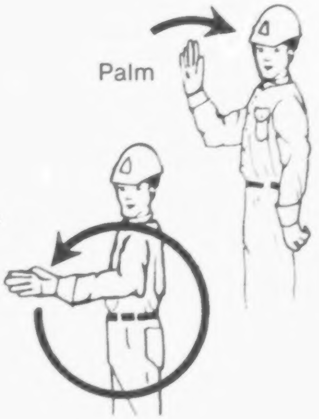


1. ____________________ 2. ____________________ 3. ____________________

F. Turn while moving







1. ____________________ 2. ____________________ 3. ____________________

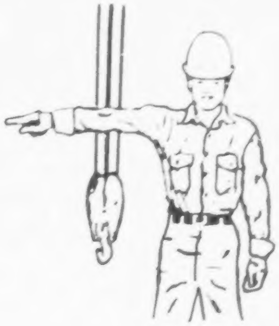
ASSIGNMENT SHEET #2

Write an "X" in the correct blanks.

G. ______1. Turn while moving

______2. Swing

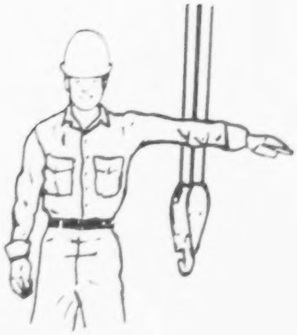
______3. Move in this direction



H. ______1. Move in this direction

______2. Stop

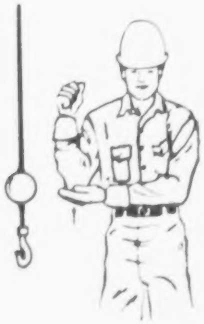
______3. Raise the boom



I. ______1. Emergency stop

______2. Rehaul or retract

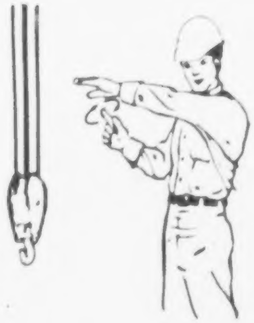
______3. Use whipline



J. ______1. Lower the boom and hold the load

______2. Lower the boom and raise the load

______3. Move slowly

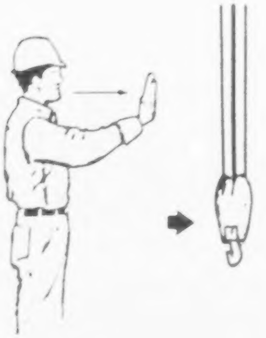


ASSIGNMENT SHEET #2

K. ______1. Lower the load

______2. Lower the boom

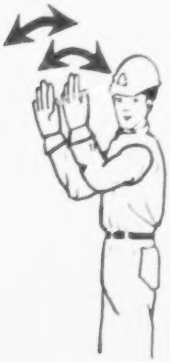
______3. Travel



L. ______1. Stop

______2. Straighten out

______3. Turn while moving



RIGGING AND MATERIAL HANDLING
UNIT III

ASSIGNMENT SHEET #3— IDENTIFY UNSAFE RIGGING PRACTICES

NAME ______________________________ SCORE ______________

The use of safe practices in rigging operations cannot be overemphasized because of the potential damage to equipment and materials and the very real possibility of injury or even death. The skilled construction worker is always alert to unsafe practices and is knowledgeable of correct procedures.

Using the illustration below, write down as many bad rigging practices as you can find. Also list any tips that are not observed in the drawing.

A. ______________________

B. ______________________

C. ______________________

D. ______________________

E. ______________________

F. ______________________

G. ______________________

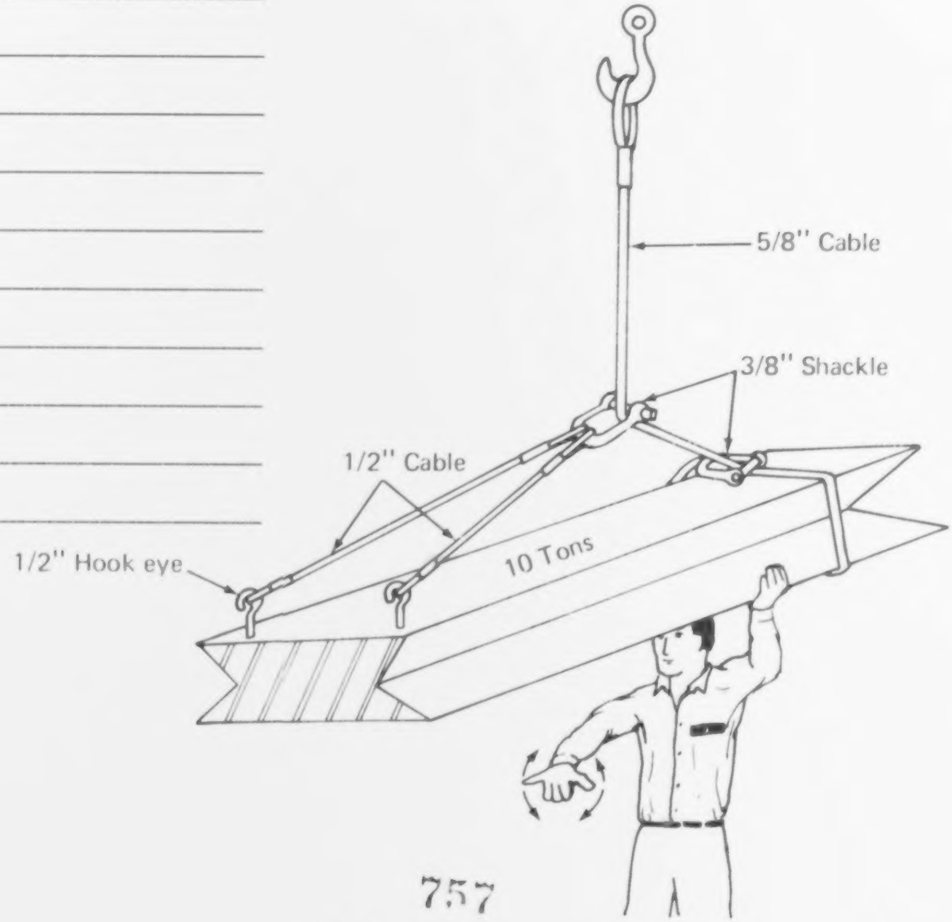
H. ______________________

I. ______________________

J. ______________________

K. ______________________

L. ______________________



RIGGING AND MATERIAL HANDLING
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. 2
B. 3
C. 1
D. 2
E. 3
F. 2
G. 1
H. 2
I. 2
J. 3

Assignment Sheet #2

A. 1
B. 3
C. 3
D. 1
E. 2
F. 2
G. 2
H. 2
I. 3
J. 3
K. 3
L. 2

Assignment Sheet #3

A. Incorrect hand signals
B. Operator cannot see hand signals
C. Hand is on load
D. Person is under load
E. No tagline
F. Load is not balanced
G. No padding on sharp edges
H. No safety latch on hook block
I. Hook eyes too small and not in far enough
J. Sling angle too small
K. All sling cables too small
L. Shackles too small

RIGGING AND MATERIAL HANDLING
UNIT III

JOB SHEET #1 — TIE KNOTS

I. Materials

   A. Two pieces of equal-sized rope

   B. One piece of different-sized rope

   C. One piece of timber or pole

II. Procedure

   A. Square knot

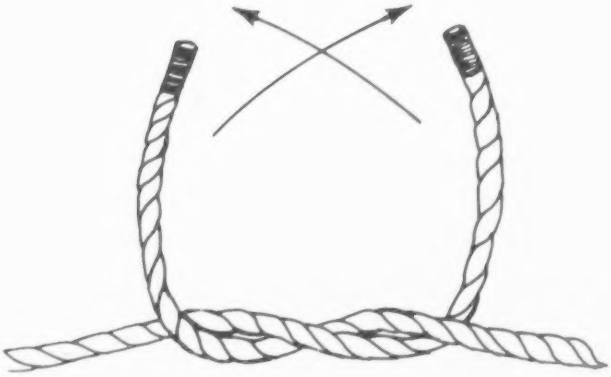
   (NOTE: When tying a square knot, remember left-over-right and right-over-left.)

      1. Use two pieces of equal-sized rope

      2. Grasp one piece of rope in each hand about eight inches from end

      3. Cross left end over right end (Figure 62)

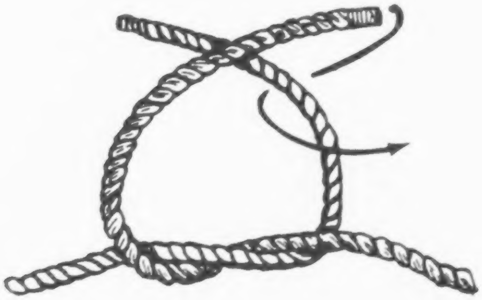
FIGURE 62



JOB SHEET #1

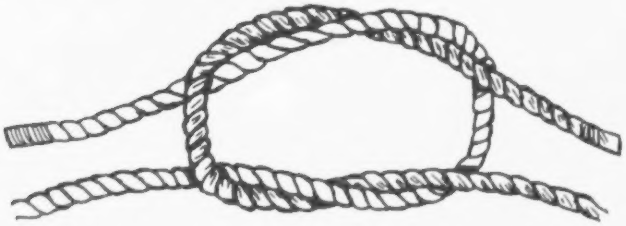
4. Cross right end over left end (Figure 63)

FIGURE 63



5. Pull the knot snug (Figure 64)

FIGURE 64

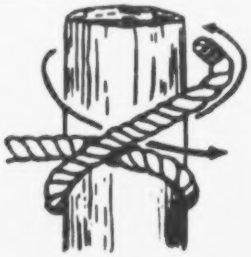


B. Clove hitch

1. Grasp one piece of rope and make one turn around a piece of timber

2. Cross the end over the standing part (Figure 65)

FIGURE 65

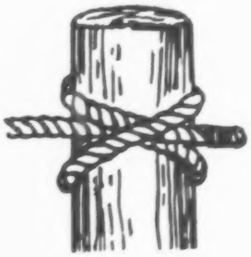


JOB SHEET #1

3. Take another turn around timber, and this time bring the end under the standing part

4. Pull the knot snug (Figure 66)

FIGURE 66

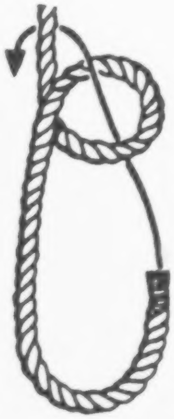


C. Bowline

1. Form an underhand loop several inches from end of rope

2. Pull rope end up through the loop from the back, leaving desired loop size (Figure 67)

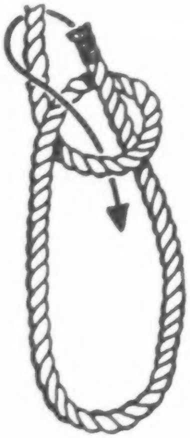
FIGURE 67



JOB SHEET #1

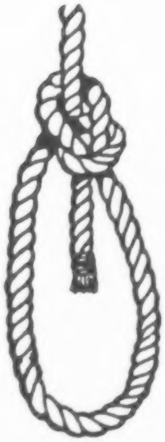
3. Twist rope end around the standing part and back through the loop (Figure 68)

FIGURE 68



4. Pull the knot snug (Figure 69)

FIGURE 69

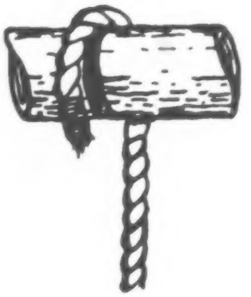


JOB SHEET #1

D. Half hitch

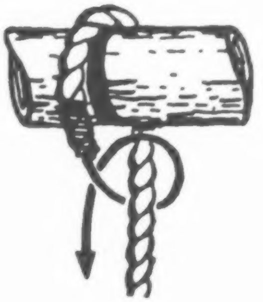
1. Make a turn over a piece of timber (Figure 70)

FIGURE 70



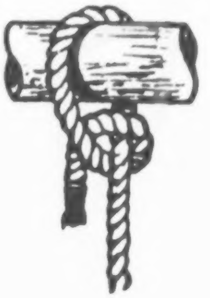
2. Make a turn behind and over the standing part and back through the loop that was formed (Figure 71)

FIGURE 71



3. Pull knot snug (Figure 72)

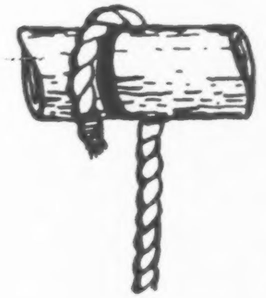
FIGURE 72



E. Two half hitches

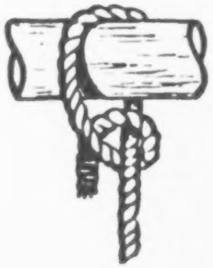
1. Make a turn over a piece of timber (Figure 73)

FIGURE 73



2. Make a turn around and over the standing part and back through the loop that was formed (Figure 74)

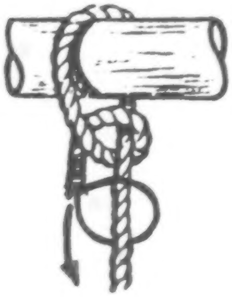
FIGURE 74



JOB SHEET #1

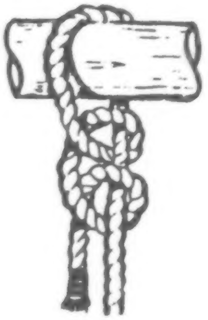
3. Make another turn around the standing part and back through the loop that formed (Figure 75)

FIGURE 75



4. Pull knot snug (Figure 76)

FIGURE 76

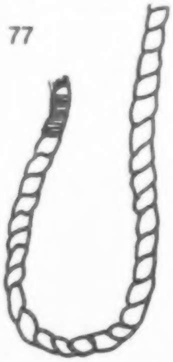


(NOTE: If the two hitches are slid together along the standing part to form a single knot, the knot becomes a clove hitch.)

F. Sheet bend

1. Form a loop on the end of one rope (Figure 77)

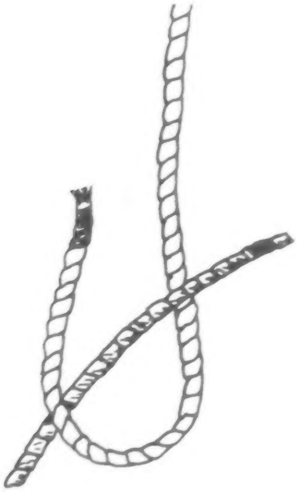
FIGURE 77



JOB SHEET #1

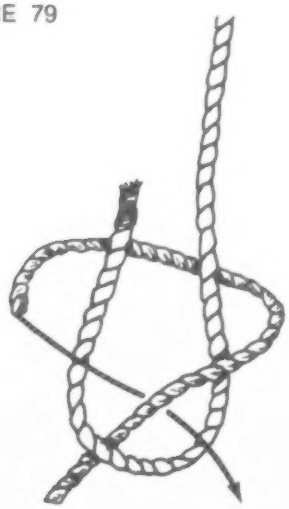
2. Lay second rope through the loop (Figure 78)

FIGURE 78



3. Twist end of second rope around standing part and running end of first rope (Figure 79)

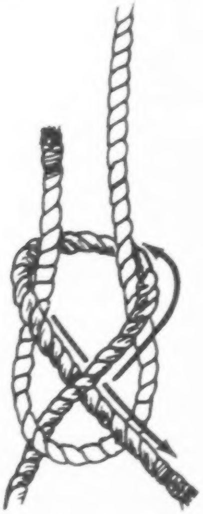
FIGURE 79



JOB SHEET #1

4. Continue bringing second rope around first rope; then run the end under standing part of itself and over first rope (Figure 80)

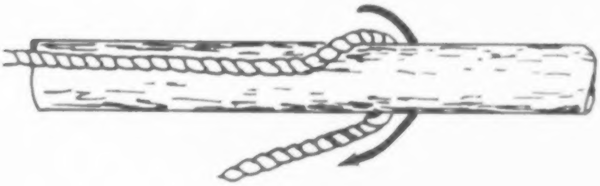
FIGURE 80



G. Timber hitch with half hitch

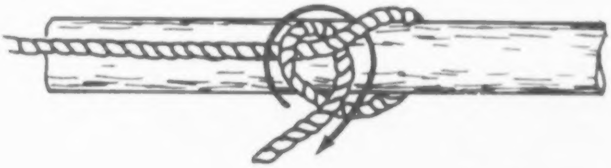
1. Lay rope lengthwise on timber; then make a turn over and around the piece of timber (Figure 81)

FIGURE 81



2. Place rope over and then under itself, forming loop (Figure 82)

FIGURE 82



JOB SHEET #1

3. Wrap end back around itself two or three times (Figures 83 and 84)

FIGURE 83

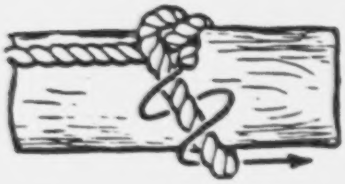
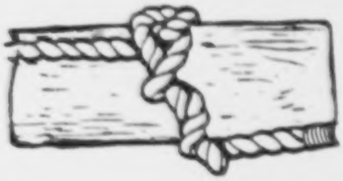


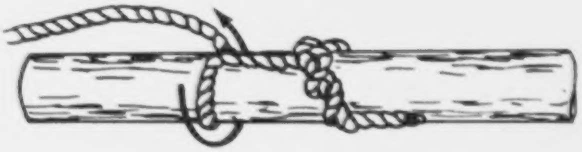
FIGURE 84



4. Pull rope so that it is snug

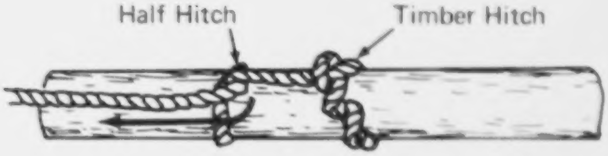
5. Pick up rope from timber, and make a loop under and around timber several inches from timber hitch (Figure 85)

FIGURE 85



6. Loop rope under itself, and then pull snug (Figure 86)

FIGURE 86



H. Store materials properly

RIGGING AND MATERIAL HANDLING
UNIT III

JOB SHEET #2 — INSTALL WIRE ROPE CLIPS

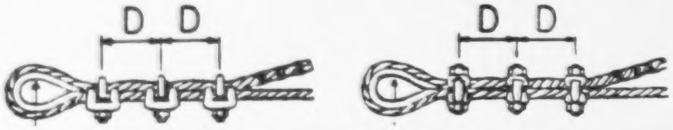
I. Tools and equipment

- A. Length of wire rope
- B. Clips, 3
- C. Thimble
- D. Wrench (to fit nuts on clips)
- E. Torque wrench

II. Procedure

- A. Determine number of clips and spacing required from Table 2

TABLE 2 — Clip and Spacing Requirements for 80 Percent of Strength

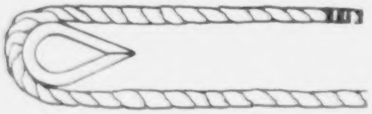


	U-BOLT CLIP		FIST GRIP CLIP	
Diameter of Wire Rope Inches	Number of Clips for Improved Plow Steel	Minimum Spacing (D) Between Clips Inches	Number of Clips for Improved Plow Steel	Minimum Spacing (D) Between Clips Inches
3/8	3	3 1/4	3	3 1/4
1/2	4	3 3/4	3	3 3/4
5/8	4	4	3	4
3/4	5	4 1/2	4	4 1/2
7/8	5	5 1/4	4	5 1/4
1	5	6	5	6
1 1/8	5	6 3/4	5	6 3/4
1 1/4	6	7 1/2	6	7 1/2
1 3/8	7	8 1/4	6	8 1/4
1 1/2	7	9	6	9

JOB SHEET #2

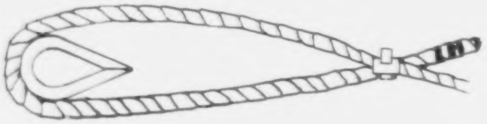
B. Turn back length of rope beyond pointed end of thimble equal to the number of clips times the clip spacing (Figures 87)

FIGURE 87



C. Position first clip at least one clip base width from end of wire rope (Figure 88)

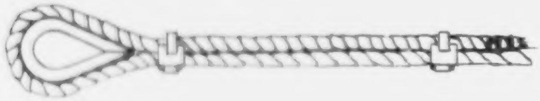
FIGURE 88



D. Tighten nuts, alternating from one side to the other to obtain equal clamping action

E. Position second clip next to end of thimble and tighten nuts until firm but not tight (Figure 89)

FIGURE 89

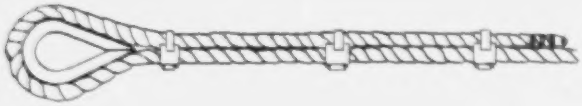


F. Space the other clips at correct positions and tighten nuts until firm

JOB SHEET #2

G. Take up any rope slack; then alternately tighten nuts on each clip until they are tight (Figure 90)

FIGURE 90



H. Torque to manufacturer's specifications

I. Put away tools and equipment

RIGGING AND MATERIAL HANDLING
UNIT III

JOB SHEET #3 — RIG AND HANDLE DIFFERENT TYPES OF LOADS, USING PROPER HAND SIGNALS

I. Equipment

- A. Hoist
- B. Load
- C. Slings
- D. Spreader bar

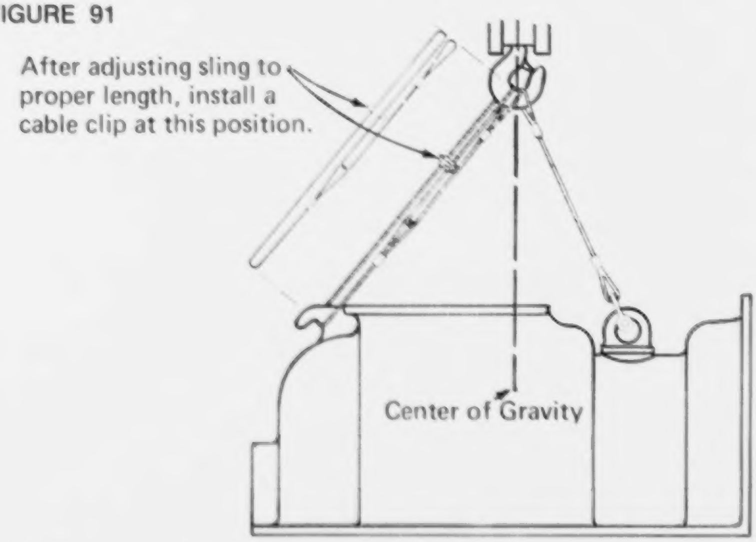
II. Procedure for load where center of gravity is not centered

> **CAUTION**
>
> For loads that appear to be extremely heavy, the exact weight of load must be determined prior to rigging to assure that load will not exceed lifting capacity of hoist or exceed safe working load of wire rope used.)

- A. Estimate location of center of gravity
- B. Spot hook over this point
- C. Attach slings of proper strength and length from hook to lifting lugs (Figure 91)

  (NOTE: Slings of different lengths will probably have to be used. Because they are not always available, it may be necessary to improvise.)

FIGURE 91



After adjusting sling to proper length, install a cable clip at this position.

Used with permission of the McGraw-Hill Book Company, from *Handbook of Rigging* by W.E. Rossnagel, 1957.

JOB SHEET #3

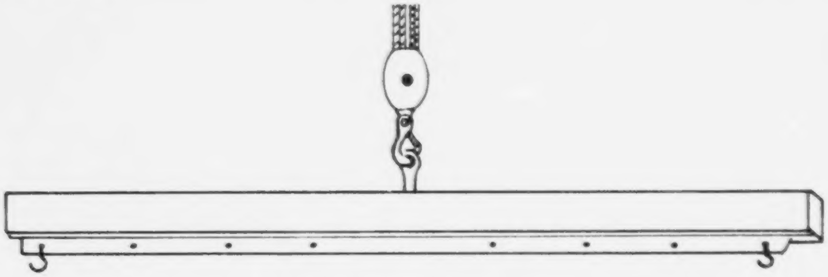
CAUTION

Be very careful that proper slings are used and that they are attached properly. Use wire rope clips if necessary.

III. Procedure for rigging extra-long loads

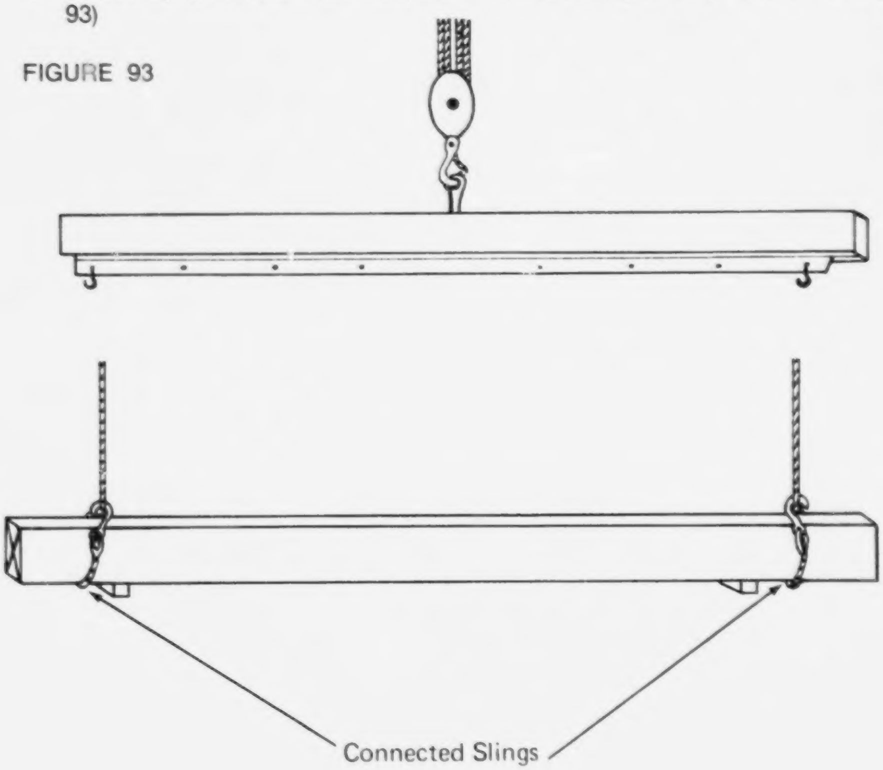
A. Attach spreader bar to hoist hook (Figure 92)

FIGURE 92



B. Center spreader bar over load; then connect sling to each end of load (Figure 93)

FIGURE 93

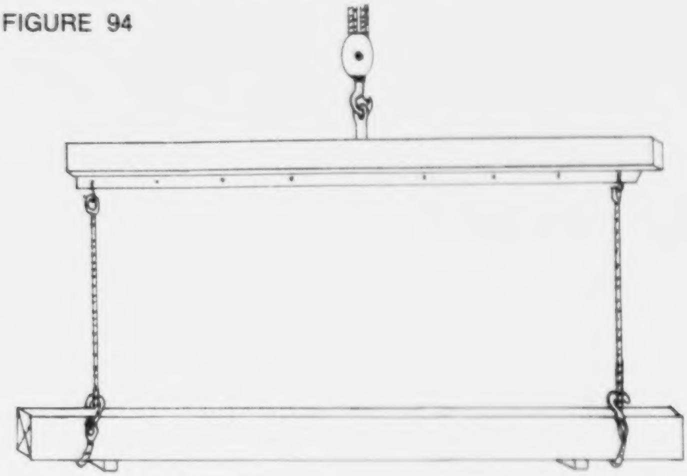


JOB SHEET #3

C. Connect long end of slings to spreader bar (Figure 94)

(NOTE: Be sure that hooks face out.)

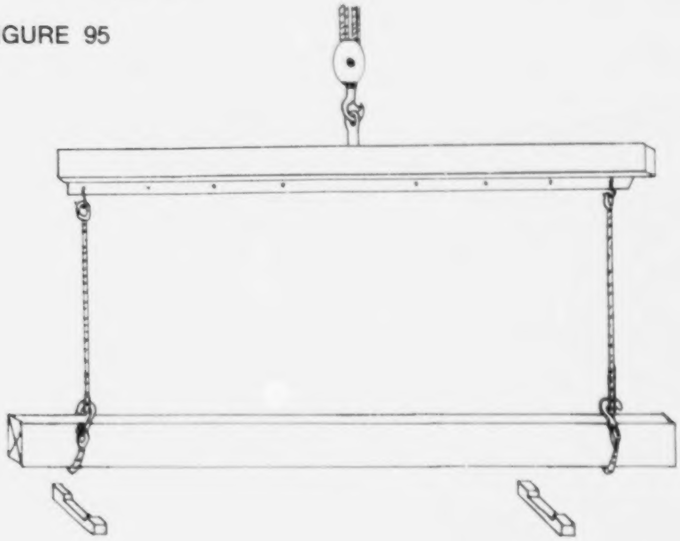
FIGURE 94



D. Give signal to hoist load slowly

E. Take up strain on line by lifting just a few inches off ground to check balance of load (Figure 95)

FIGURE 95



JOB SHEET #3

F. Give signal to stop

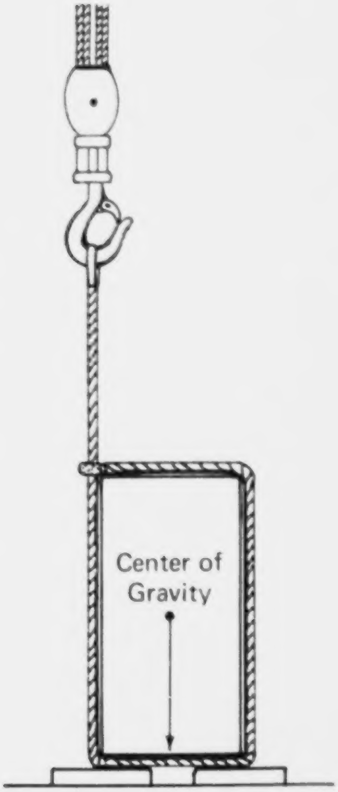
G. Give signal to lower load

IV. Procedure for turning or rotating a load

A. Attach single sling so that the part of sling leading from hoist hook will go directly to bottom of load (Figure 96)

(NOTE: Be sure hook points away from hoist.)

FIGURE 96



B. Attach sling to hook

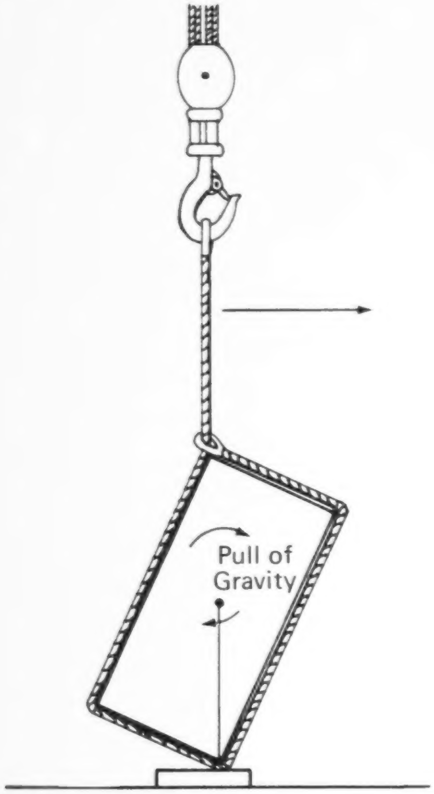
C. Give hand signal to hoist load and move boom so hook will move forward

JOB SHEET #3

D. When load is just clear of surface, give signal to stop hoisting

(NOTE: This will cause load to tilt. See Figure 97.)

FIGURE 97



E. Give signal to move hook forward

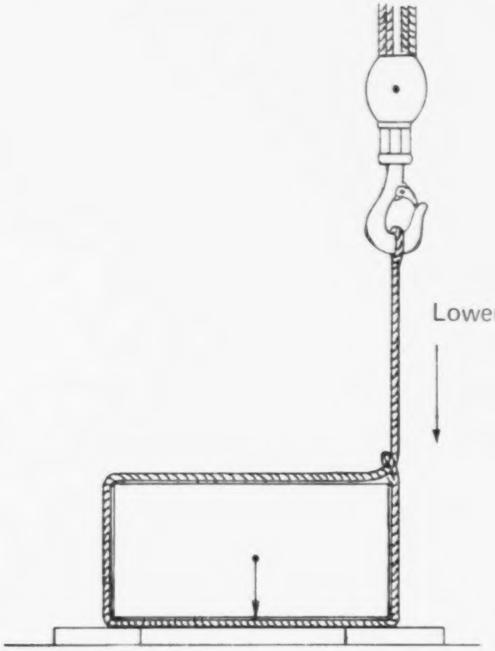
F. Give signal to stop movement when load is in position

G. Give signal to lower the hook and move forward slowly

(NOTE: This will allow the load to rotate slowly to a flat position. See Figure 98.)

JOB SHEET #3

FIGURE 98



H. Store equipment properly

RIGGING AND MATERIAL HANDLING
UNIT III

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with rigging to their correct definitions. Write the correct numbers in the blanks provided.

______a. Grooved wheel or pulley

______b. To attach a rope to a post, pole, ring, hook, or other object

______c. Rope used to guide or steady load while being lifted

______d. To pull from below the load, but not directly under it

______e. Pounds per square inch

______f. Assembly of blocks and lines used to gain a mechanical advantage in lifting

______g. Setting up block and tackle to a winch, stacking and hoisting material and equipment, or replacing cables on equipment

______h. Preliminary shaping of wires so that they will lie in place

______i. Direction, length, or angle of twist of the strands in a rope or cable

______j. Pulley in a case that can be easily fastened to lines or objects by means of a hook, ring, or shackle

______k. Material used in the center of wire rope

______l. Devices used to prevent crushing of load and to lift extra long and heavy loads

______m. To join two sections of rope or cable together to form a continuous length

______n. Metal loop that engages a hook

______o. Grooved metal ring inserted in loop in rope to prevent wear

______p. Slang meaning to slow down the work pace deliberately

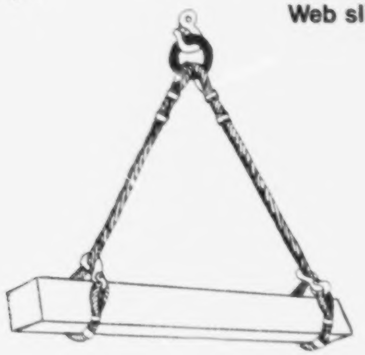
______q. Point at which entire weight may be considered as concentrated

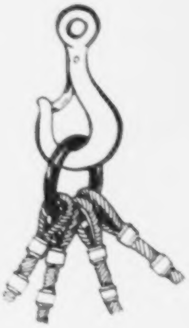
1. Center of gravity
2. Core
3. Dog
4. Eye
5. Heave
6. Hitch
7. Lay
8. Preforming
9. psi
10. Rigging
11. Sheave
12. Snatch block
13. Splice
14. Spreaders
15. Tackle
16. Tagline
17. Thimble

TEST

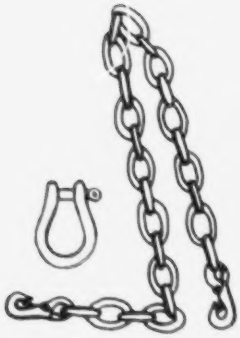
2. Identify the following accessories used for load lifting. Write the correct names in the blanks provided.

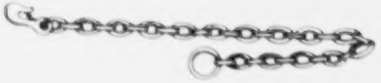
Bull chain
Bridles
Chokers (single slings)
Chain and shackle
Spreader bars
Grommet sling
Web sling





a. ______________________________

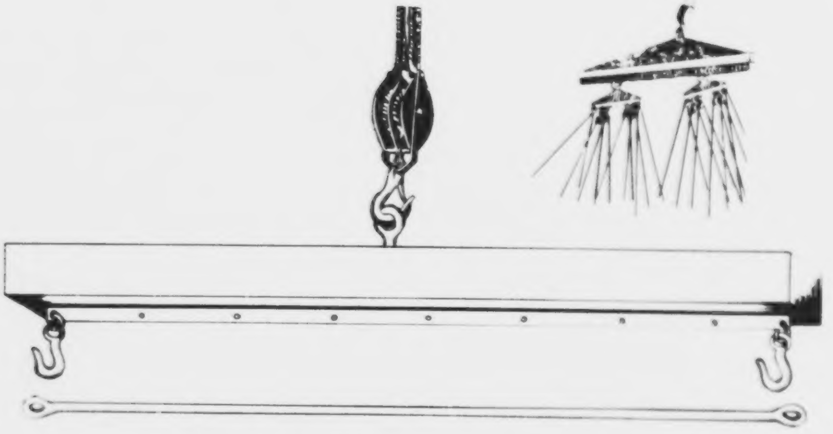




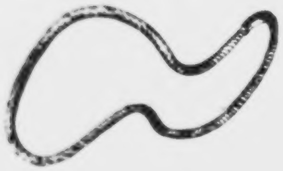
b. ______________________________

c. ______________________________

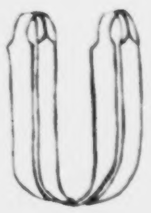
TEST



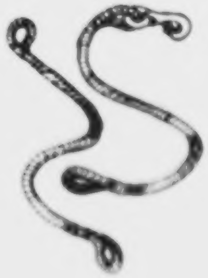
d. ______________________________



e. ______________________________



f. ______________________________

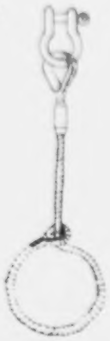


g. ______________________________

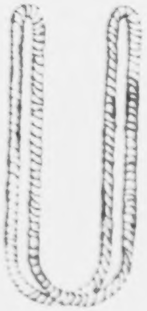
TEST

3. Identify the following hitches used for attaching materials and equipment to the hoist. Write the correct names in the blanks provided.

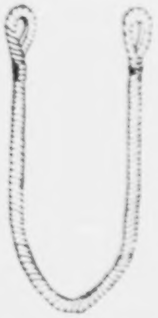
Choker hitch sling
Basket hitch sling
Choker hitch choker
Basket hitch choker
Inverted basket hitch sling



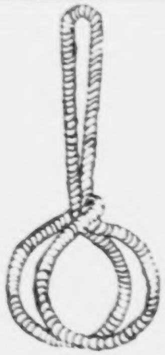
a. ______________________________



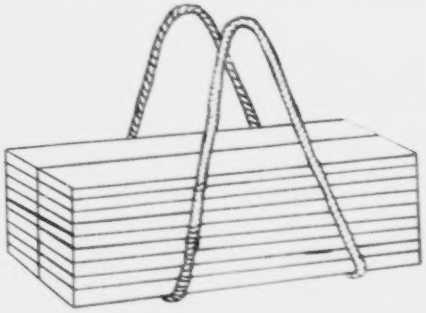
b. ______________________________



c. ______________________________



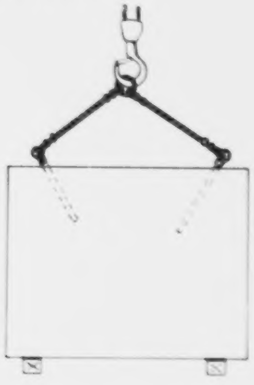
d. ______________________________



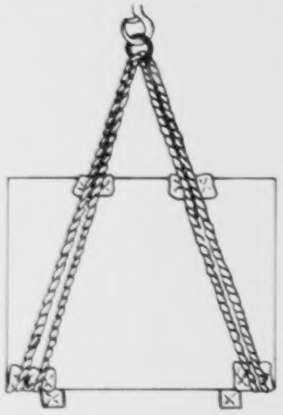
e. ______________________________

TEST

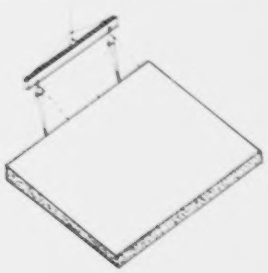
4. Label the following devices and types of rigging used to handle panels. Write the correct names in the blanks.



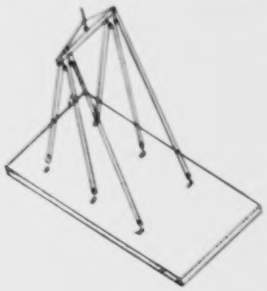
a. ______________________________



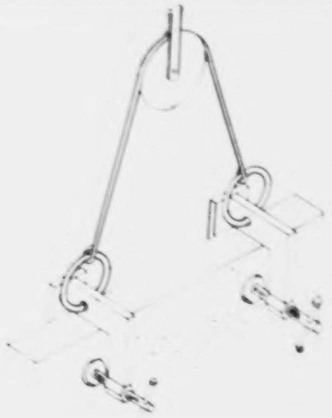
b. ______________________________



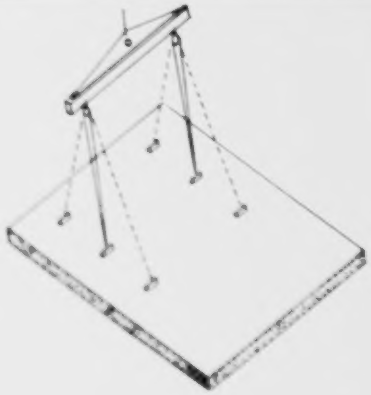
c. ______________________________



d. ______________________________

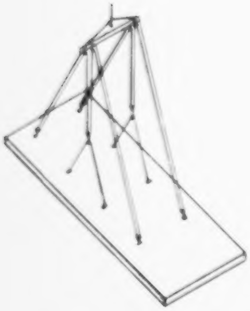


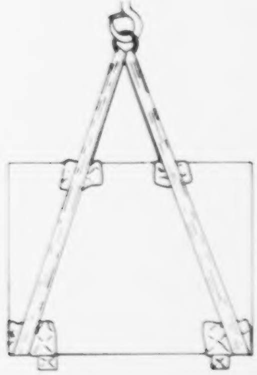
e. ______________________________



f. ______________________________

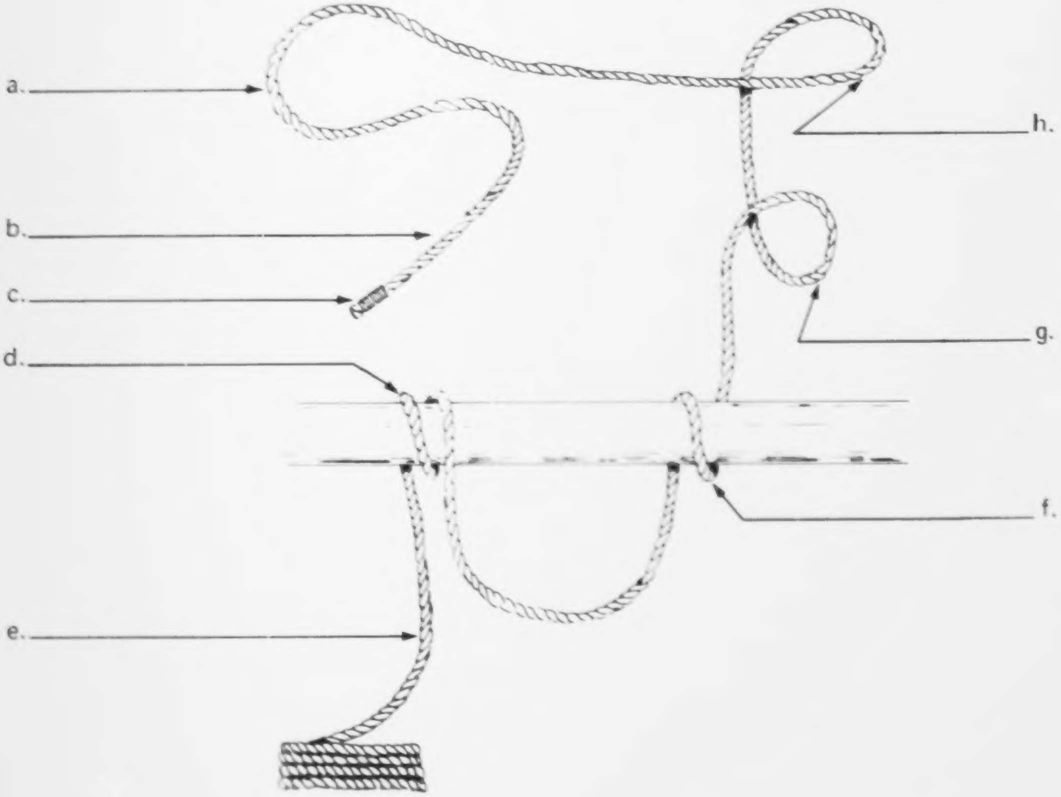
TEST





g. ______________________ h. ______________________

5. Label elements of knots, bends, and hitches. Write the correct names in the blanks.



TEST

6. Match types of knots to their correct uses. Write the correct numbers in the blanks provided.

______a. Holds timber securely when moving heavy timber or poles

______b. Forms a strong running loop that is convenient for running an eye; can also provide a choker-type sling at the end of a line

______c. Fastens a line to timber or pipe

______d. Ties line to timber or to a larger line

______e. Secure the running end of a line to the standing part

______f. Fastens a line to a hook; generally used temporarily

______g. Ties two lines of equal size together so that they will not slip

______h. Ties two lines of unequal size together; also used to tie a line to an eye

______i. Holds heavy timbers or poles for lifting or dragging

______j. Supports ends of scaffold plank and prevents it from tilting

______k. Forms a single loop that will not tighten or slip under strain

1. Blackwall hitch
2. Bowline
3. Clove hitch
4. Half hitch
5. Running bowline
6. Scaffold hitch
7. Sheet bend
8. Square knot
9. Timber hitch
10. Timber hitch with half hitch
11. Two half hitches

7. State five safety tips related to rigging.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

TEST

8. Match types of rope materials to their correct characteristics. Write the correct numbers in the blanks provided.

______a. Strong and durable; used where dependability, ability to stand up under severe use, and resistance to weathering are required

______b. Low durability and strength; low cost

______c. Very strong, high abrasion resistance, good resistance to weathering, and high degree of stretch

______d. Less strength than nylon; little stretch

______e. Slightly less strength than nylon; little stretch; very light, actually floats on water and is resistant to rot

______f. Less strength than nylon; high stretch; excellent resistance to mildew, decay, acids, and alkalies

1. Polypropylene
2. Nylon
3. Manila
4. Polyester
5. Polyethylene
6. Sisal

9. Explain general construction of rope.

____

____

____

____

____

____

____

10. State six precautions to observe when caring for ropes.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

TEST

11. State the importance of sling angles.

a. ______________________________

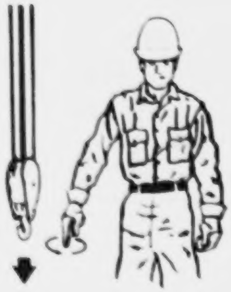
____

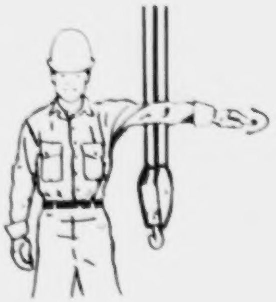
b. ______________________________

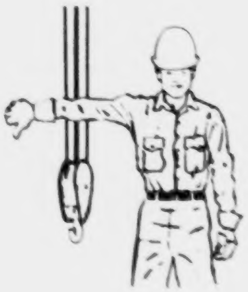
____

12. Distinguish among hand signals used in rigging operations. Write an "X" in the blank under each correct illustration.

a. Lower the boom

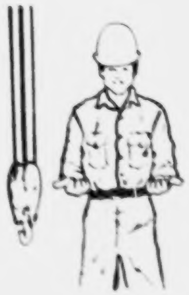


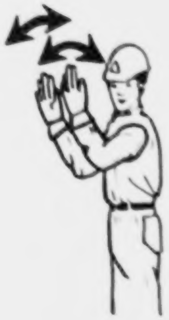


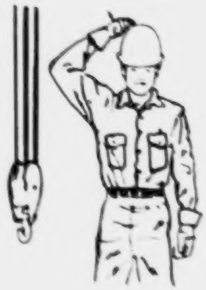


1) ______________ 2) ______________ 3) ______________

b. Straighten out



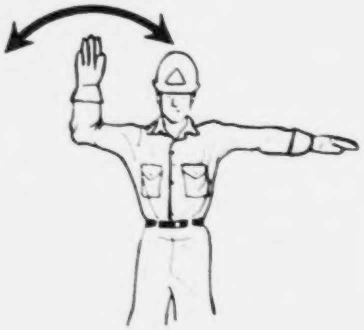


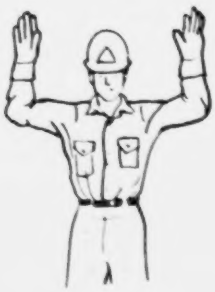


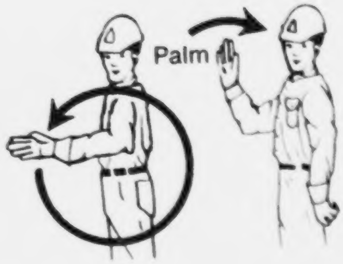
1) ______________ 2) ______________ 3) ______________

TEST

c. Move backwards

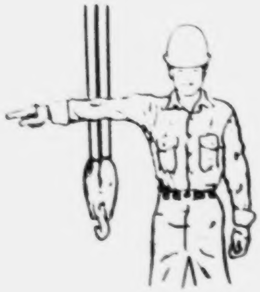


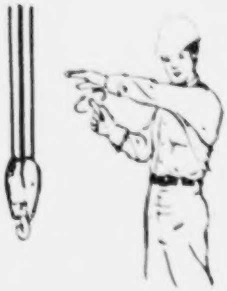


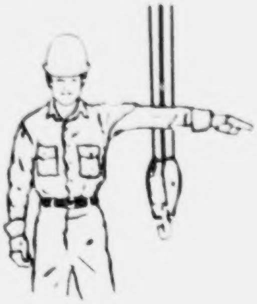


1) ____________________ 2) ____________________ 3) ____________________

d. Swing

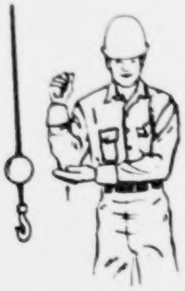


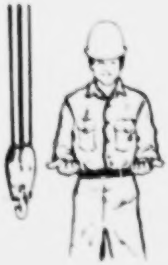


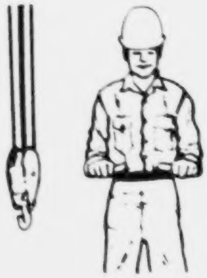


1) ____________________ 2) ____________________ 3) ____________________

e. Retract boom



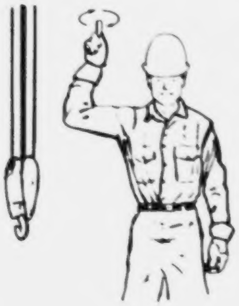


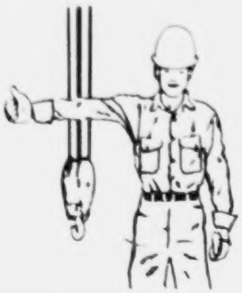


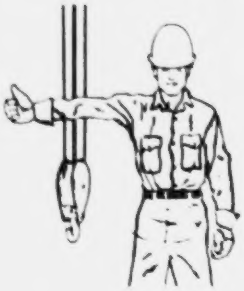
1) ____________________ 2) ____________________ 3) ____________________

TEST

f. Raise the boom and lower the load

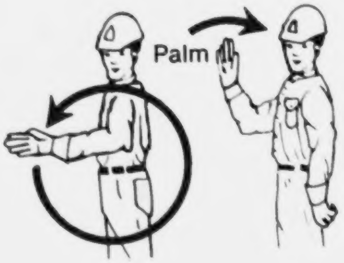






1) ____________________ 2) ____________________ 3) ____________________

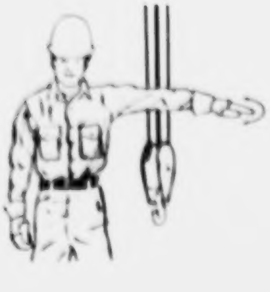
Write an "X" in the correct blanks.



g. ______1) Swing in direction finger points

______2) Move in this direction

______3) Turn while moving



h. ______1) Stop

______2) Dog

______3) Emergency stop

TEST

13. Select from the following list good rigging practices. Write an "X" in the correct blanks.

_____a. Pad all sharp corners and edges

_____b. Use tagline to pull loads

_____c. Wrap rope around hook when not in use

_____d. Center crane over load before lifting

_____e. Give all hand signals clearly and correctly

_____f. Secure all unused sling lines

_____g. Turn hooks to face hoist

_____h. Never allow a shackle to be pulled at an angle

_____i. Unlock load as soon as it is low enough to reach

_____j. Use a shackle whenever two or more ropes are to be used over a hook

_____k. Keep machines at least twenty-five feet (25') from all electrical equipment

_____l. Do not use screw pin shackle if the pin can roll under load and unscrew

_____m. Never make vertical lifts on eye bolts

_____n. Do not permit rope to bend near a splice or attached fitting

_____o. Use shackles on chokers where there may be cutting action

_____p. Use thimbles in eye splices

_____q. For proper sling angle, be sure length of slings is always greater than the span between the two connections

(NOTE: Test items 14-16 list assignment sheets and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

RIGGING AND MATERIAL HANDLING
UNIT III

ANSWERS TO TEST

1. a. 11
   b. 6
   c. 16
   d. 5
   e. 9
   f. 15
   g. 10
   h. 8
   i. 7
   j. 12
   k. 2
   l. 14
   m. 13
   n. 4
   o. 17
   p. 3
   q. 1

2. a. Bridles
   b. Chain and shackle
   c. Bull chain
   d. Spreader bars
   e. Grommet sling
   f. Web sling
   g. Chokers (single slings)

3. a. Choker hitch choker
   b. Basket hitch sling
   c. Basket hitch choker
   d. Choker hitch sling
   e. Inverted basket hitch sling

4. a. Lewis pins and bridle
   b. Chokers or slings
   c. Basic edge lift
   d. High rigging modified for panels of various widths
   e. Stone clamps
   f. Basic two-point lift
   g. High rigging with approximately equal loads
   h. Straps or web slings

5. a. Bight
   b. Running end
   c. Whipping
   d. Round turn
   e. Standing part
   f. Turn
   g. Underhand loop
   h. Overhand loop

ANSWERS TO TEST

6. a. 9
   b. 5
   c. 3
   d. 4
   e. 11
   f. 1
   g. 8
   h. 7
   i. 10
   j. 6
   k. 2

7. Answer should include any five of the following

   a. Use personal protective devices such as goggles, gloves, safety shoes, and hard hats
   b. Use tagline to guide or steady load
   c. Do not walk under load
   d. Be sure load is balanced properly
   e. Do not overload equipment
   f. Use corner saddles, padding, or wood blocking to protect slings from sharp bends and sharp edges
   g. Stand clear when slings are heaved from under loads
   h. Avoid heavy or continuous overloading
   i. Be sure outriggers or stabilizers are in use and are on solid footing
   j. Lubricate slings to prevent rust
   k. Be sure all hooks have safety snaps
   l. Be extra cautious around power lines

8. a. 3
   b. 6
   c. 2
   d. 4
   e. 1
   f. 5

9. Answer should include

   a. Rope is normally made of three strands, each of which is made of several threads
   b. The rope itself is twisted in a right-hand direction while each strand is twisted in a left-hand direction and the individual threads are twisted in a right-hand direction
   c. Reversal of twist in strands gives the rope a balance or set, which eliminates the tendency to unwind

10. Answer should include any six of the following

   a. When taking rope from a coil, always remove it from the center in a counterclockwise direction
   b. When rope is not in use, re-coil it in a clockwise direction
   c. When rope is attached to a hook, ring, or pulley block, place a thimble in the loop or eye to reduce wear and to decrease stress
   d. Protect rope from moisture and weather as much as possible
   e. Do not disturb a frozen rope until it is completely thawed

ANSWERS TO TEST

f. Keep rope away from acids, other chemicals, and heat
g. Do not drag rope over ground or sharp edges
h. If possible, do not make abrupt bends in rope
i. Wash and dry dirty rope before storing it
j. Store rope so that air may circulate around it
k. If manila rope becomes stiff and hard because of being wet, treat it with a thin lubricating oil or warm petrolatum (a jellylike petroleum-based dressing.)

11. a. Decreasing angle of sling leg increases stress on the sling
b. As the angle is reduced, lifting capacity decreases very rapidly

12. a. 3
b. 2
c. 3
d. 1
e. 3
f. 2
g. 2
h. 3

13. a, d, e, f, h, j, l, n, o, p, q

14. Evaluated to the satisfaction of the instructor

15. Evaluated to the satisfaction of the instructor

16. Performance skills evaluated to the satisfaction of the instructor